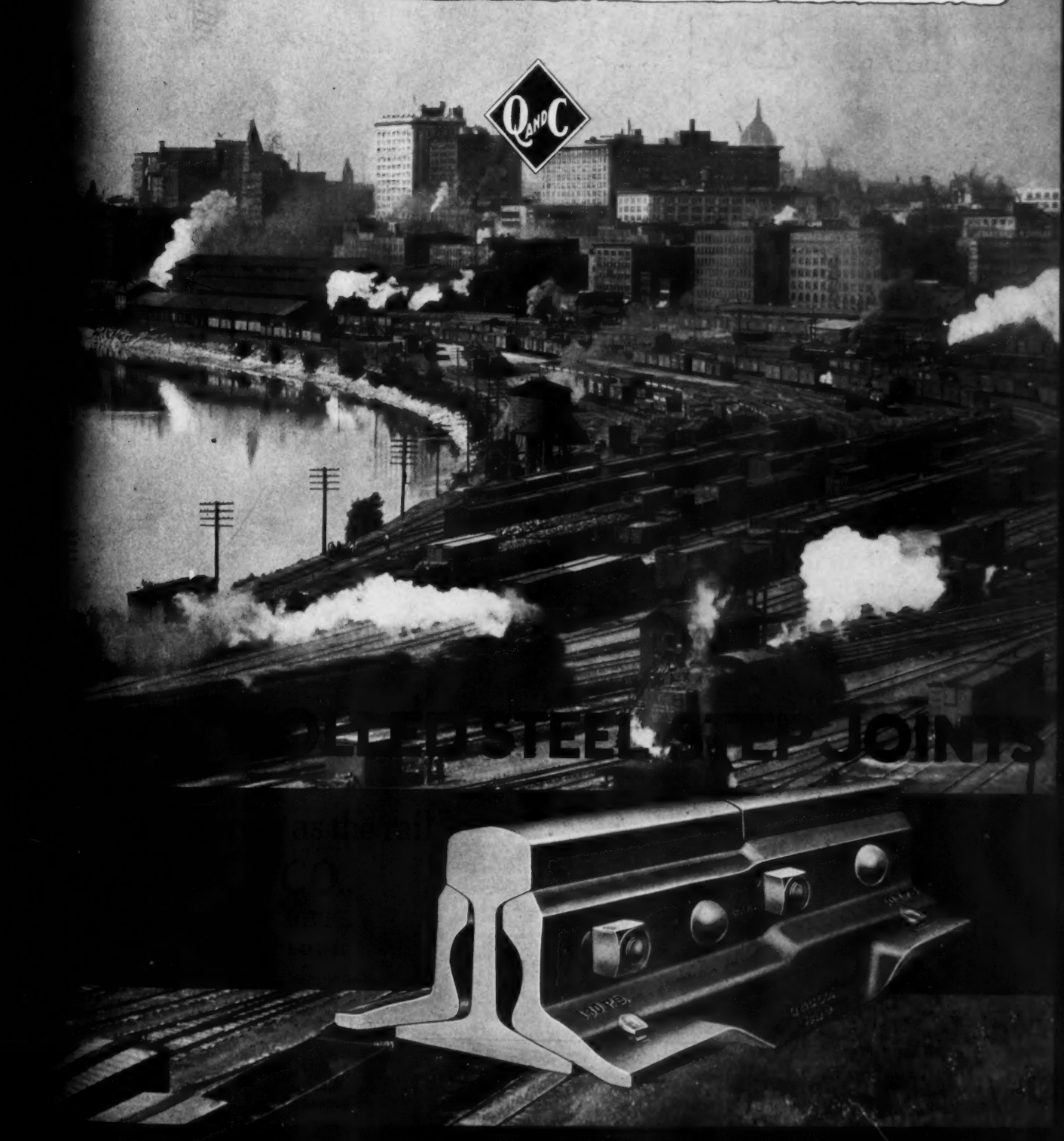
OCTOBER, 1924

ROADMASTER'S CONVENTION NUMBER

COPY FOR BINDER
DO NOT CUT

Railway Engineering and Maintenance



HY-CROME

THROUGH longer life and a greater exertion of fatigue resistance HY-CROME serves more economically—the value of a nut lock is measured by service, not price.

THE RELIANCE MFG. CO.
MASSILLON, OHIO

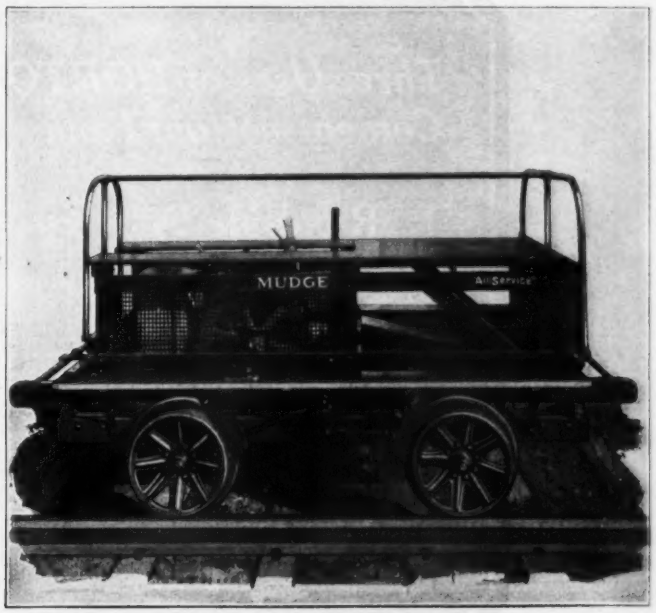
New York, Cleveland, Detroit, Chicago, St. Louis, San Francisco

Engineering Materials, Ltd., McGill Building
Montreal, Quebec, Canada.

RAILWAY ENGINEERING AND MAINTENANCE
Entered as second-class matter June 23, 1916, at the post office at Chicago, Ill., under the Act of March 3, 1879. Published monthly by Simmons-Boardman Publishing Company at 608 S. Dearborn St., Chicago. Subscription price, United States, Canada and Mexico, $2.00 a year; foreign countries, $3.00 a year.

Alphabetical Index to Advertisers, Page 46 Classified Index to Advertisers, Pages 44 and 46

Proved Dependability and Economy



THE record of the past sixteen years proves that Mudge Motor Cars have met the demands of the railroads for

Dependability
Low Maintenance Costs
Economical Operation

It is a simple matter today (with Mudge cars operating on a majority of Class I Roads) to learn definite facts regarding Mudge dependability and economy.

A Complete Line of Section and Inspection Motor Cars; Side Drive or Center Load; Free Running or Direct Connected; Air Cooled or Water Cooled Motors

Mudge & Company

Manufacturers—Railroad Equipment
Railway Exchange Bldg. • CHICAGO

THERE'S A MUDGE FOR EVERY JOB

Three Uses of HORTON Conical-bottom Tanks

1. Roadside Delivery
2. For Removal of Suspended Matter
3. For Water-treating Plants

Standardize *on the* Tank that Does 3 Things

In a recent report to his superiors an engineer said, "By installing the conical-bottom Horton tank at roadside stations we can provide tanks which are easily adaptable to softening tanks when we obtain authority for treating our water."

This far sighted view is one in which many engineers participate, and we commend it to the men to whose attention this adaptability of the Horton tank may not have come.

The three-fold use of the conical-bottom tank enables the engineering or water service department to standardize upon one type of tank for all purposes.

We should like to mail *you* some accounts of actual experiences with the Horton tank.

Chicago Bridge & Iron Works

CHICAGO 2452 Old Colony Bldg.
DALLAS 1646 Praetorian Bldg.
SAN FRANCISCO 1007 Rialto Bldg.
NEW YORK 3156 Hudson Terminal Bldg.
ATLANTA 1036 Healey Bldg.

337

HORTON TANKS

The Trans-Canada of the C. P. R. Which Makes the Trip from Montreal to Vancouver in 90 Hours.

Railway Engineering and Maintenance

Formerly the Railway Maintenance Engineer

Vol. 20 **October, 1924** **Number 10**

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HENRY LEE, *Vice-Pres. and Treasurer*
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C. R. MILLS, *Vice-President*
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ROY V. WRIGHT, *Secretary*
F. C. KOCH, *Business Manager*

WOULD YOU LIKE TO KNOW

How improvements in the quality of water reduce boiler repairs?
What rail brands mean?
How cinders may be disposed of economically?
How to avoid the use of work trains?
How to make the best concrete form various aggregates?

Answers to these and other practical questions will be found elsewhere in this issue.

ELMER T. HOWSON, *Editor*
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Request for change of address should reach us two weeks before the date of the issue with which it is to go into effect. It is difficult and often impossible to supply back numbers to replace those undelivered through failure to send advance notice.

In sending us change of address please be sure to send us your old address as well as the new one.

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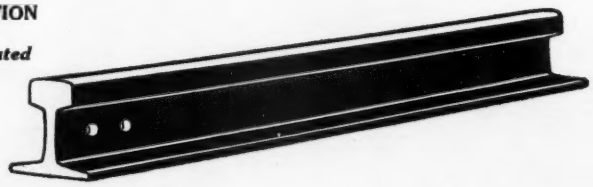
Railway Engineering and Maintenance is a member of the Associated Business Papers (A. B. P.) and of the Audit Bureau of Circulations (A. B. C.)

STANDARD SECTION
TEE RAILS
Rolled from Reheated Blooms



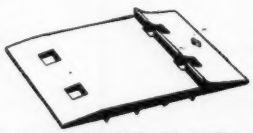
INLAND
BASIC OPEN HEARTH
STEEL PRODUCTS

INLAND
TRACK ACCESSORIES
from Basic Open Hearth Steel

INLAND SPLICE BARS
All Standard Specifications Accurately Produced

INLAND TRACK BOLTS
Medium Carbon—High Carbon Heat Treated—Oil Quenched

INLAND TRACK SPIKES
A. R. E. A and other Standard Designs



INLAND TIE PLATES
Medium—Copper Alloy—High Carbon, Hot Worked and Annealed

YOU can depend on INLAND Basic Open Hearth Steel Products. The careful selection of raw material and the complete control of manufacture throughout ***all*** processes insure maintenance of the highest standards.

In addition to rails and track accessories INLAND makes:

Sheet Steel—Black, Blue Annealed and Galvanized
Inland Copper Alloy Sheets
Special Locomotive Jacket Sheets
Car Shapes
Structural Shapes
Universal Mill Plates
Sheared Plates
Reinforcing Bars
Merchant Bars
Boiler and Structural Rivets

INLAND STEEL COMPANY
38 South Dearborn Street, Chicago
Branch Offices: **Milwaukee St. Paul St. Louis**
Mills at: **Indiana Harbor, Ind. Chicago Heights, Ill. Milwaukee, Wis.**

"Send Us Some More of the Big *International* Ties"

—said the Roadmaster

WHEN he emphasized big—he meant *International* Ties. He said BIG—because the *International* Ties were bigger and contained more timber than the general run of ties he was receiving. This roadmaster was a good judge of value too.

He wanted MORE—because he knew the perfect uniformity and the mechanical soundness of *International* Ties would give longer and more dependable service than heretofore received from "just ties."

International Ties are always sound, quality ties, inspected and graded in strict accordance with standard A. R. E. A. specifications, carefully and accurately seasoned and treated with pure creosote oil or zinc chloride.

But that is not all—as a proof of our integrity and our confidence in the grade quality and service life of *International* Ties—we place a copper monogramed dating nail in every tie as a permanent record for your inspection at any time.

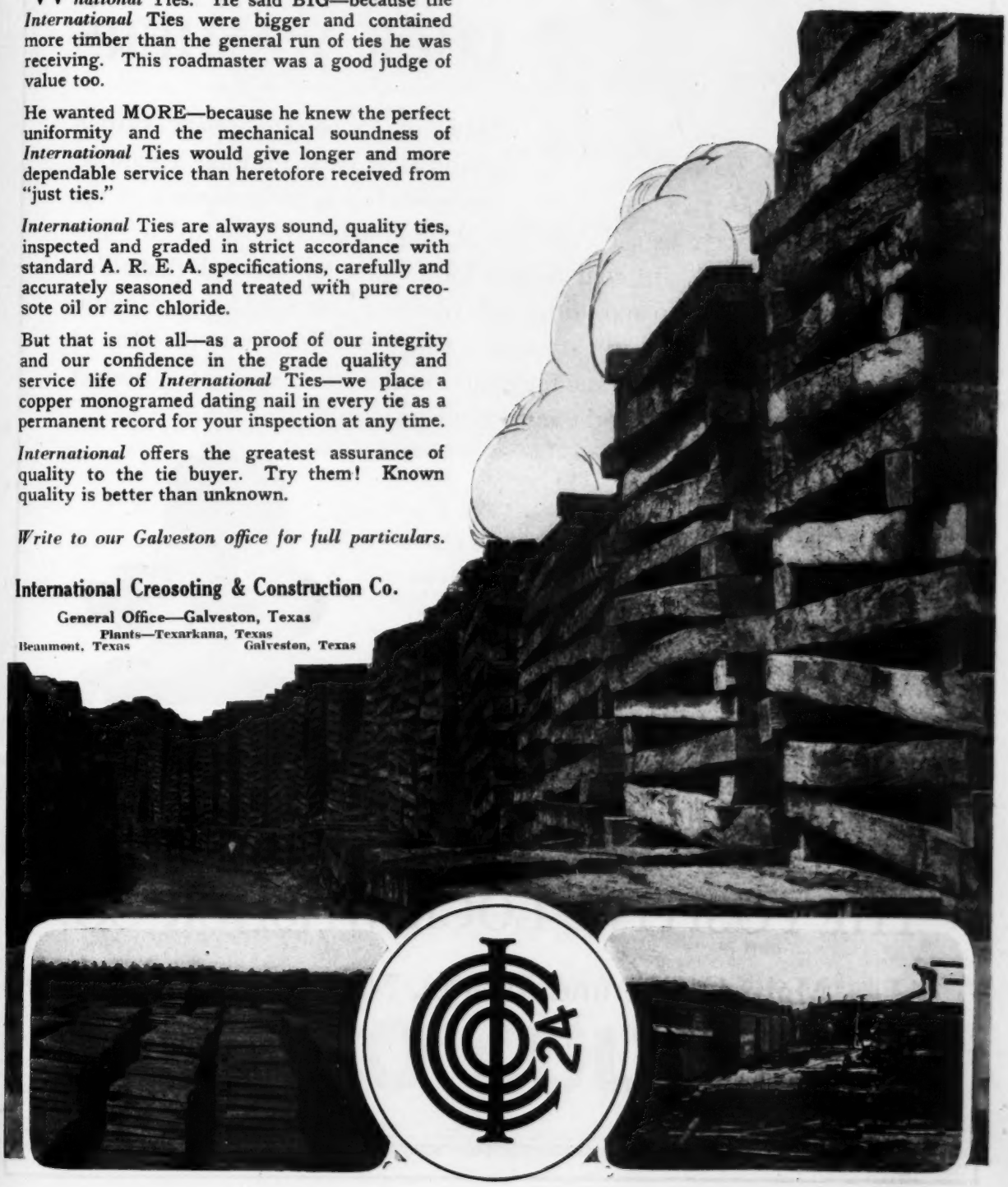
International offers the greatest assurance of quality to the tie buyer. Try them! Known quality is better than unknown.

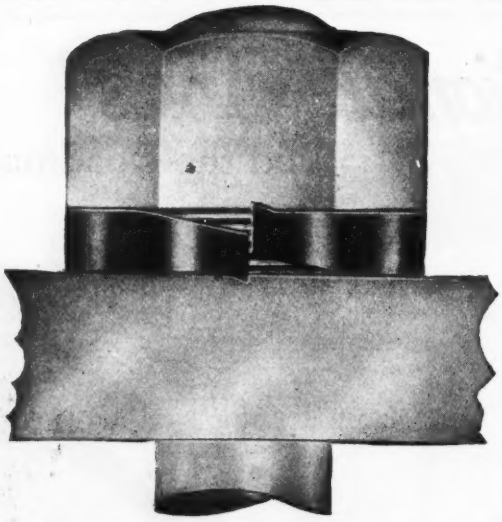
Write to our Galveston office for full particulars.

International Creosoting & Construction Co.

General Office—Galveston, Texas

Plants—Texarkana, Texas
Beaumont, Texas Galveston, Texas



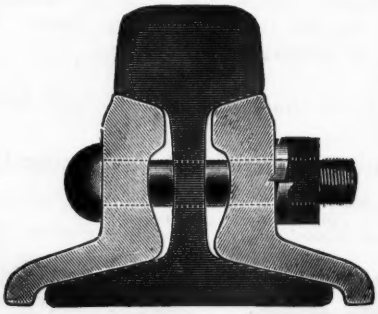


Genuine POSITIVE LOCK WASHERS

Made of "Keystone" shape carbon spring steel bars, forming a parallel face with full bearing surface of the entire washer, except at each end just behind the positive "barbs" or "ratchet". These "barbs" are cold forged, forming the tapered ends that allow the "positive" to take up and utilize any vibration that might occur, vibration that tends to loosen ordinary lock washers, and bites into the face of the lock washer on one side and the plates on the other, forming a perfect ratchet and thus preventing the nut from backing off.

Positive

Plain



WE ALSO MAKE PLAIN TYPE LOCK WASHERS

THE POSITIVE LOCK WASHER CO.

Main Office and Works, Newark, N. J.

FOREIGN OFFICE
80-84 James Watt St.
Glasgow, Scotland

PACIFIC COAST OFFICE
H. L. Van Winkle Company
160 Beale St.
San Francisco, Calif.

ARMCO Culverts in Railway Service

No. 11 of a Series

Location: Main line of well-known Southern Railway.

Traffic: Heavy freight and passenger.

Installation Data: A 14 gauge, 24-inch ARMCO Culvert under light fill of gravel and cinders installed 1913.

Condition: Excellent. No sign of corrosion. Inspected and photographed, 1922.

Remarks: This is one of hundreds of light gauge, ARMCO Culverts that are giving excellent service under adverse conditions of installation and heavy traffic. Present installation practice for railways calls for a fill at least equal to the culvert diameter and at least 12 gauge metal for 24-inch diameter.

There is a manufacturer in almost every state and in Canada, making Culverts, Flumes, Siphons, Tanks, Roofing, etc., of genuine, rust-resisting Armco Ingot Iron. Write for full information and nearest shipping point on products in which you are interested

Ingot Iron

ARMCO CULVERT & FLUME MFRS. ASS'N. 215 North Michigan Avenue, Chicago

ARMCO CULVERTS

AIR Operated Extension Side Dump Cars save time—save labor—and should be regarded as labor saving machines. This equipment is doing excellent work in railway ditcher service and steam shovel service along main lines where it is handling big yardage and dumping same in quick order.

Whole trains of these cars are also being used in cinder service. The cars are loaded at the terminals and taken out on the main line and dumped without danger of traffic delays. In view of the quick dumping feature, ashes, which would otherwise be wasted, are used for bank widening jobs and other maintenance of way work.

Quick and positive dumping is accomplished by tilting the body. During this operation the side of the car turns out and down forming a chute over which the entire load is discharged far from the track. By looking at any of the illustrations showing the cars in full dumped position you will note that this chute is entirely free and clear to permit the uninterrupted discharge of any load regardless of sizes and shapes of individual pieces.

Clark Car Company

Oliver Building, Pittsburgh, Pa.

New York Office,
52 Vanderbilt Ave.

Chicago Office,
122 South Michigan Ave.

PITTSBURGH

Air does the dumping.

Saves time and labor

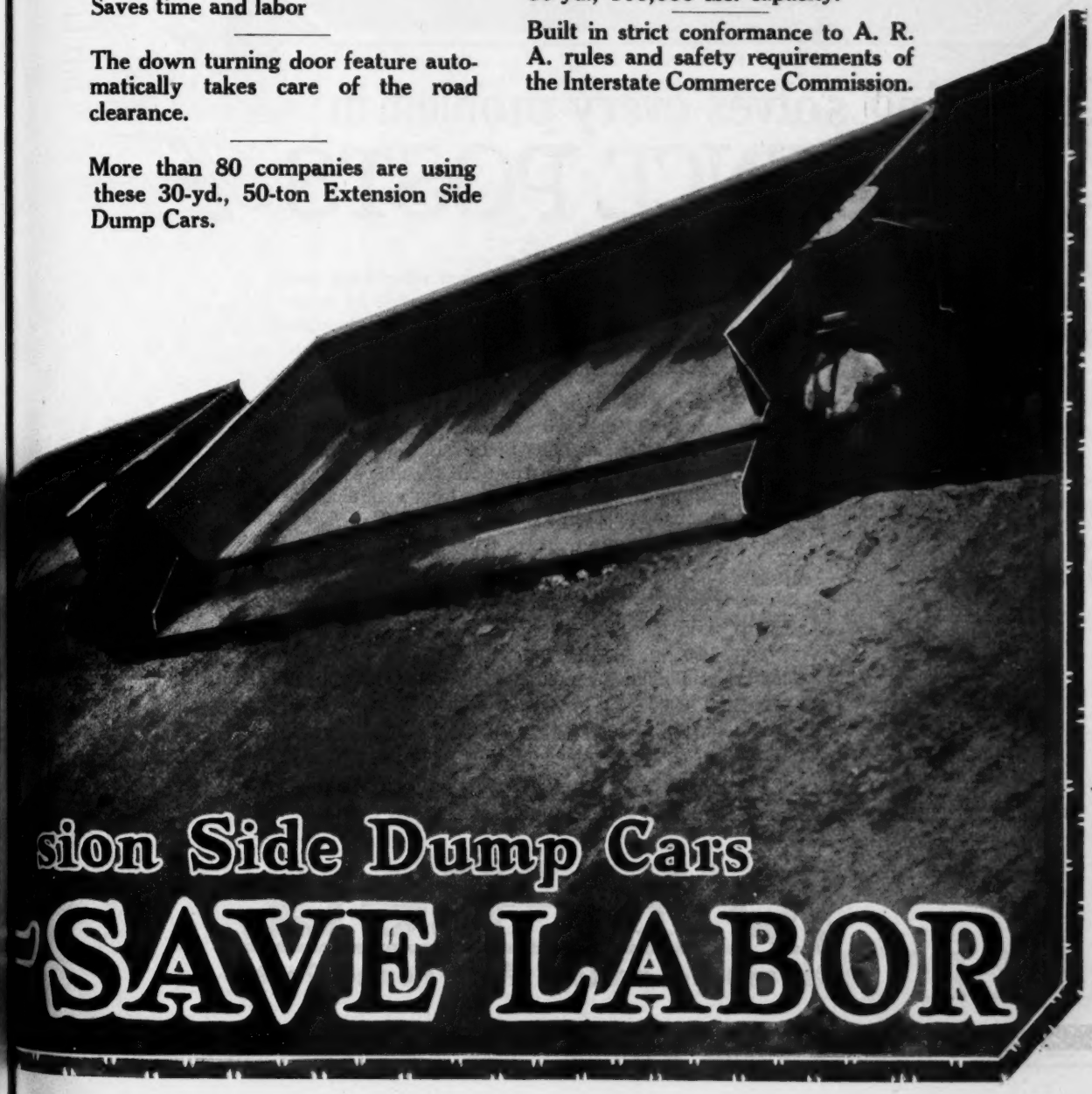
The down turning door feature automatically takes care of the road clearance.

More than 80 companies are using these 30-yd., 50-ton Extension Side Dump Cars.

Big loads unloaded quickly.

30-yd., 100,000 lbs. capacity.

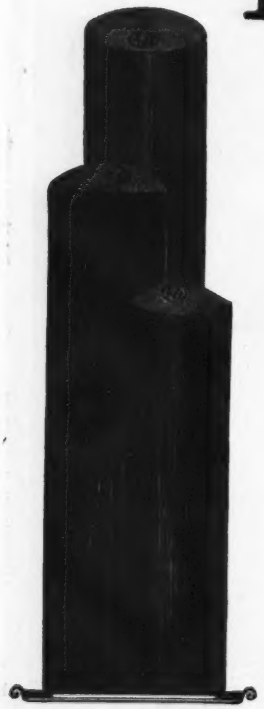
Built in strict conformance to A. R. A. rules and safety requirements of the Interstate Commerce Commission.



sion Side Dump Cars

SAVE LABOR

Creosoting solves every problem in FENCE POSTS



Made in Full Round, Sawed Halves and Sawed Quarters.

SECTION foremen are well pleased when Long-Bell Creosoted Yellow Pine Posts are specified by maintenance-of-way engineers because these posts reduce the labor of keeping up right-of-ways. It is unnecessary to clear grass away from fences when Long-Bell Posts are used.

Preserving full length with creosote, by the pressure-vacuum process, makes Long-Bell Posts resistant to fire and decay. A report of the American Wood Preservers' Association gives these interesting facts regarding the fence posts used by a large western railroad:

A total of 2,030,911 posts in service, 1,651,333 untreated and 378,578 treated. 5,795 of the untreated posts were burned by right-of-way fires as against a damage of only 76 treated posts.

The constantly increasing use of creosoted ties, piling and bridge timbers by railroads is proof of the value of preserved wood. So why not creosoted fence posts?

Write for Further Information about these posts that reduce maintenance labor and expense.

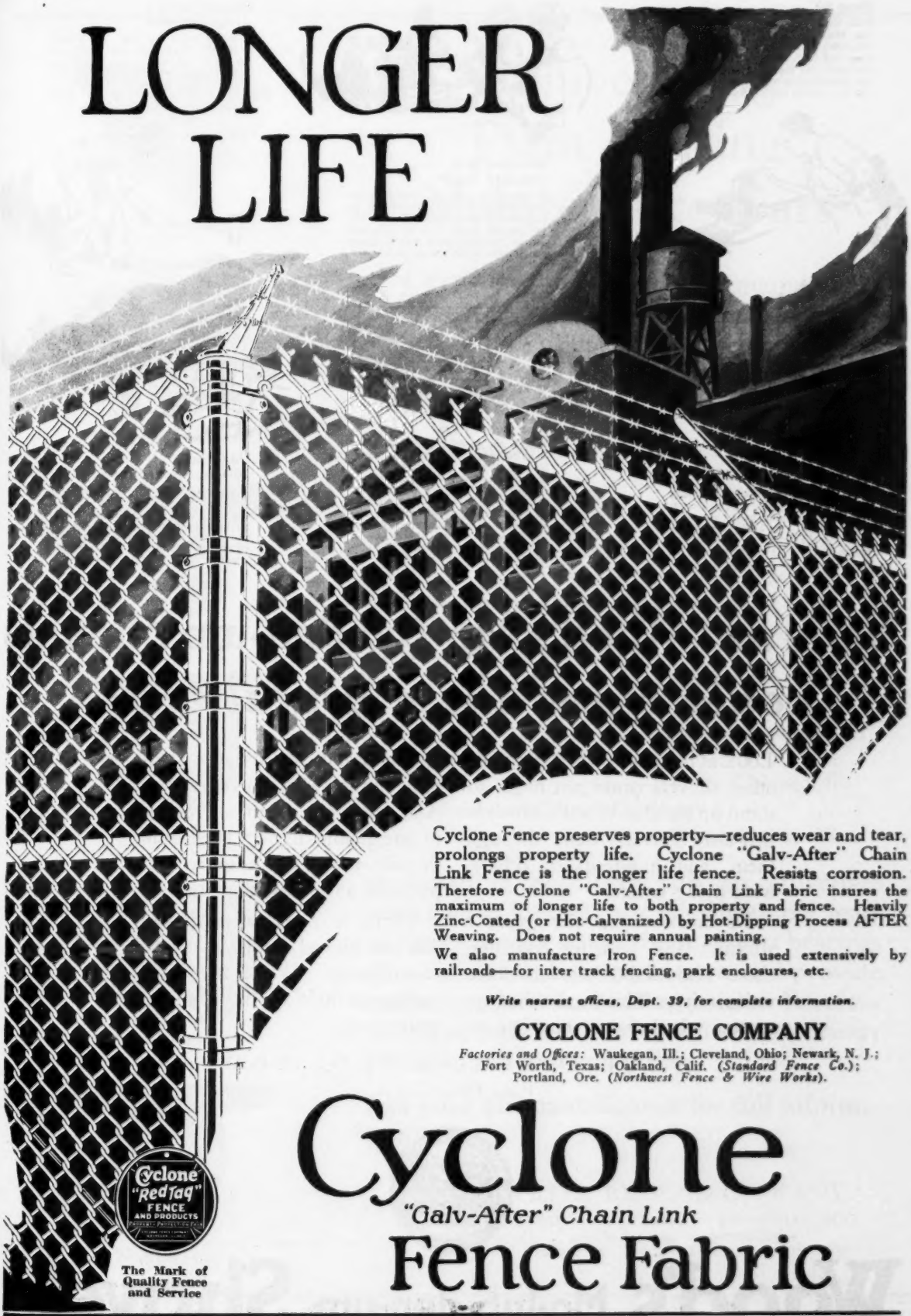
The Long-Bell Lumber Company

813 R. A. Long Building Kansas City, Mo.

Long-Bell

Creosoted Yellow Pine Fence Posts

LONGER LIFE



The Mark of Quality Fence and Service

Cyclone Fence preserves property—reduces wear and tear, prolongs property life. Cyclone "Galv-After" Chain Link Fence is the longer life fence. Resists corrosion. Therefore Cyclone "Galv-After" Chain Link Fabric insures the maximum of longer life to both property and fence. Heavily Zinc-Coated (or Hot-Galvanized) by Hot-Dipping Process AFTER Weaving. Does not require annual painting.

We also manufacture Iron Fence. It is used extensively by railroads—for inter track fencing, park enclosures, etc.

Write nearest offices, Dept. 39, for complete information.

CYCLONE FENCE COMPANY

Factories and Offices: Waukegan, Ill.; Cleveland, Ohio; Newark, N. J.; Fort Worth, Texas; Oakland, Calif. (*Standard Fence Co.*); Portland, Ore. (*Northwest Fence & Wire Works*).

Cyclone

"Galv-After" Chain Link

Fence Fabric

PROPERTY PROTECTION PAYS

Bent 90°

With the edge placed in a vise, you can bend a Wood's Mo-*lyb*-den-um Moulder's Shovel forward ninety degrees and back without harming it in the least—no fracture, no permanent set, no indication of the punishing test. Try it. It's an old test for this shovel.

As a strong man tested it

One company had its local strong man test the Wood's Mo-*lyb*-den-um Shovel by chopping hunks out of a concrete wall. He couldn't break or bend the shovel or, to quote, "even find a mark on it where it came in contact with the concrete."

Dropped in a concrete mixer

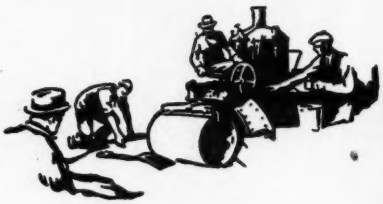
A workman put a concrete mixer temporarily out of commission by accidentally dropping a Wood's Mo-*lyb*-den-um Shovel into it. The only damage to the shovel was a broken handle—the blade was as good as new.

The factory test

This is the factory testing machine. It holds 2-inch and 4-inch red granite blocks. Wood's Mo-*lyb*-den-um and other shovels are fastened to the spindle, and rotated through the granite. Wood's shovel went through 80 miles of granite, lifted 3485 tons and was still serviceable. The best test of a competitive shovel was 15 miles, lifting approximately 700 tons, before going out of commission.

Slugged with a sledge-hammer

A husky made this test. He placed a Wood's Mo-*lyb*-den-um Scoop on the floor and swung on it with a sledge-hammer—hit it with all his might. This terrific wallop, which would have cracked most any other scoop, didn't even dent this one.



Under a 10-ton steam roller

A contractor wanted to flatten the blade of a sample Wood's Mo-*lyb*-den-um Shovel that was sent him. So he placed it upside down on a concrete road and had a ten-ton steam roller pass over it *four times* with no apparent effect—didn't even dent it.

None but Wood's Mo-*lyb*-den-um Shovels *could stand these brutal tests*

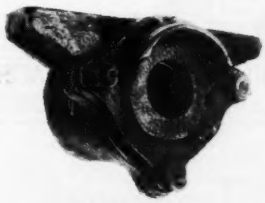
LOOK at these tests—tests that any other shovels could not begin to stand up to. But Wood's Mo-*lyb*-den-um Shovels went through them, and hundreds of others, with flying colors.

In addition to far greater strength and wearing qualities, these remarkable shovels have uniformity. This means that, no matter whether you buy one or one thousand, you are sure of the same high quality in every shovel. And they are from six ounces to one pound lighter than other shovels—which means more work per man and happier workers.

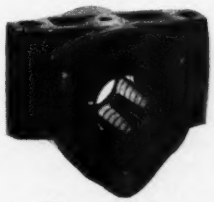
There is a Wood's Mo-*lyb*-den-um Shovel for every shovel requirement. Write for information on their application to all your needs.

THE WOOD SHOVEL & TOOL COMPANY
Piqua, Ohio, U. S. A.

Wood's Mo-lyb-den-um Shovels
The American Super Steel

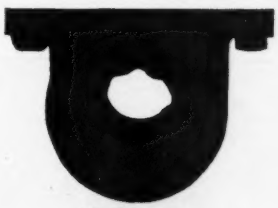


Buda



Fairbanks-Morse

Fairmont



Kalamazoo

Mudge

Northwestern

Rejuvenating Plain Bearing Maintenance Cars

WHEN you overhaul your maintenance cars this fall, you will have an opportunity to give them new life by discarding their plain bearings and installing Hyatt roller bearing replacement boxes.

The following manufacturers furnish complete Hyatt bearing boxes ready to be bolted on your old cars:

The Buda Company . . . . . Chicago, Ill.
Fairbanks, Morse & Company . . . . . Chicago, Ill.
Fairmont Railway Motors, Inc. . . . . Fairmont, Minn.
Kalamazoo Railway Supply Company, ... Kalamazoo, Mich.
Mudge & Company . . . . . Chicago, Ill.
Northwestern Motor Company. . . . . Eau Claire, Wis.

By installing these boxes you can rejuvenate your cars at low cost and get additional years of better service out of them. Hyatt bearings eliminate plain bearing friction and provide real strength at the bearing points. Result—saving of fuel, less lubrication required, easy running and longer car life.

Ask your car manufacturer for full information.

HYATT ROLLER BEARING COMPANY
NEWARK DETROIT CHICAGO SAN FRANCISCO
WORCESTER PHILADELPHIA PITTSBURGH
CLEVELAND MILWAUKEE

HYATT ROLLER BEARINGS FOR RAILWAY MAINTENANCE CARS

TAYLOR-WHARTON IRON & STEEL CO.

TIOGA STEEL & IRON CO. | WM WHARTON Jr. & CO. INC. | PHILADELPHIA ROLL & MACHE

WHARTON

Space No. 40
Hotel Commodore, New York
September 16, 17, 18

Special Trackwork

Samples of our work are on exhibition at the annual Roadmasters' Convention. Visiting roadmasters are invited to inspect this exhibit while in New York.

Our experience in the design and appliance of special trackwork has kept pace through all phases of development from the beginning of the industry. Our facilities for the production of this class of work are unsurpassed.

William Wharton, Jr. & Co., Inc.
Easton, Pennsylvania

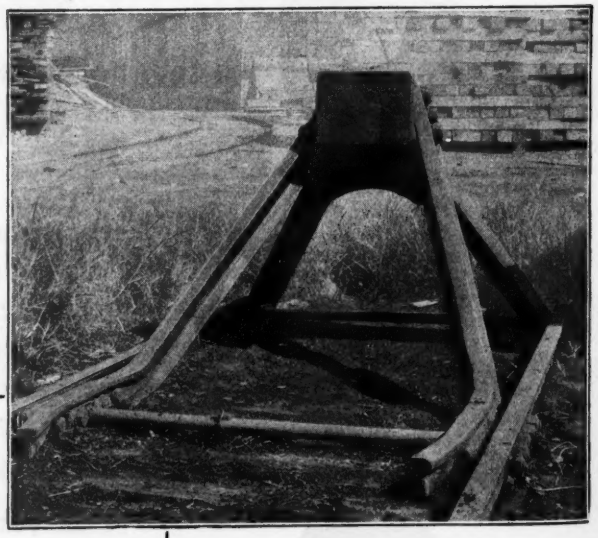
Taylor Wharton Iron & Steel Co.	Wm. Wharton Jr. & Co.	Tioga Steel & Iron Co.	Philadelphia Roll & Machine Co.
Plant at High Bridge, N. J.	Plant at Easton, Pa.	Plant at Philadelphia, Pa.	Plant at Philadelphia, Pa.
Manganese Steel Wearing Parts	Special Trackwork Cylinders for Gases	Hammered and Pressed Forgings	Rolls and Rolling Mill Machinery

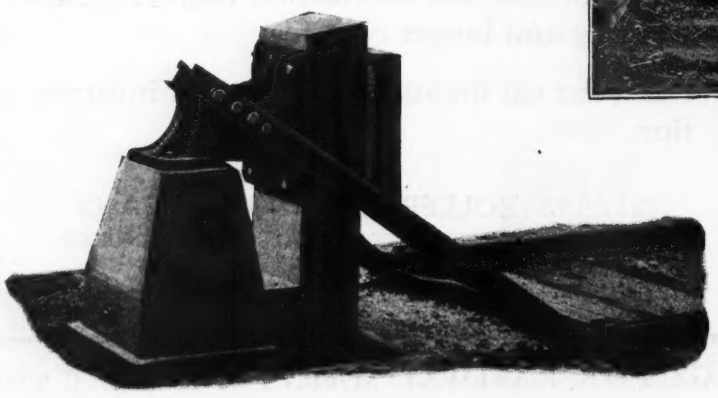
The Bumping Post Twins

No matter how similar they may be in general characteristics, no twins are ever exactly alike. Each has his own individuality. So with the Durable and Ellis bumping posts. They are products of the same plant—alike in general design and quality workmanship—but each with its own individual advantages adapting it for certain uses.

The Ellis is the oldest and best known bumping post on the market, and is unsurpassed where cars must be stopped regardless of consequences. The Durable is of all-metal construction, used where simplicity of installation, all parts above ground, and minimum occupancy of track space are essential.

This pair of twins will meet all your requirements for bumping post protection. Make them standard and use each to best advantage.





Above—The Durable At Left—The Ellis.

Descriptive Literature on Request

MECHANICAL MANUFACTURING COMPANY

Pershing Road and Loomis Street
CHICAGO, ILLINOIS

Loading one of the bore holes for the big Frazier blast.

250,000 Tons of Stone in One Shot!

WHEN the Chesapeake & Ohio Railroad needs ballast they start a young earthquake and shake down a hill to get it.

In what is believed to be the largest quarry shot ever made in the South, a quarter of a million tons of stone recently were thrown down and well broken at the Frazier Ballast Quarries, Frazier, West Virginia.

Fifty-eight thousand pounds of du Pont explosives were used on the job—42,000 pounds of 60 per cent Gelatin and about 16,000 pounds of Red Cross Extra 40%. Cordeau Bickford was used throughout as a detonator with trunk line connection. Including explosives and labor, this shot cost nearly $30,000.

The responsibility of planning and firing this $30,000 shot was given to a du Pont explosives expert.

For railroad work, du Pont leads in the manufacture of explosives and blasting powder. Experts are available to assist in selecting the type that will do YOUR work best at least cost.

E. I. DU PONT DE NEMOURS & CO., Inc.
Explosives Department
Wilmington, Delaware

DU PONT EXPLOSIVES

Branch Offices:

Birmingham . Ala.
Boston . . Mass.
Buffalo . . N. Y.
Chicago . . . Ill.
Denver . . Colo.
Duluth . . Minn.
El Paso . . . Tex.
Huntington . W.Va.
Joplin . . . Mo.
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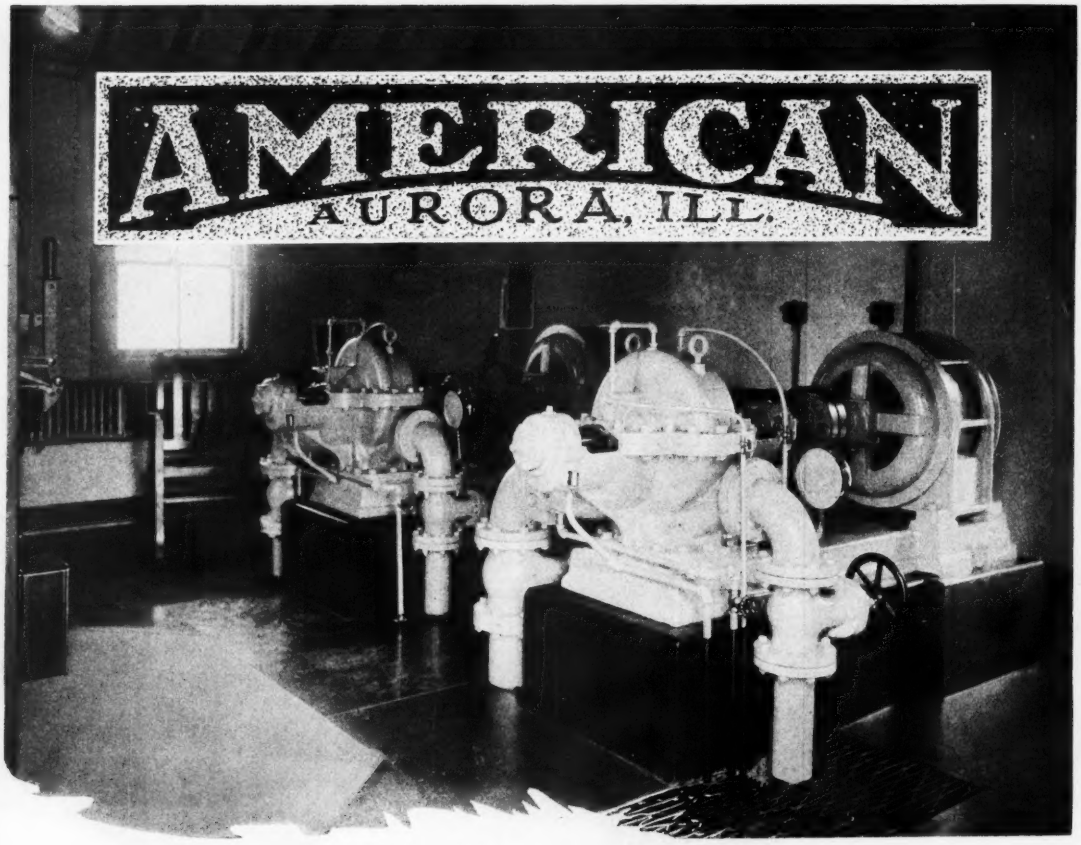
St. Louis . . Mo.
San Francisco Calif.
Scranton . . Pa.
Seattle . . Wash.
Spokane . . Wash.
Springfield . . Ill.

Du Pont Products Exhibit
Atlantic City, N. J.



An Ideal Pumping Plant!

An ideal pumping plant is in operation on the H. McKay Twombley estate at Madison, New Jersey.

Two American Deep Well Power Heads, operating against a head of 135 ft., pump the water from the ground into a reservoir. These power heads have a stroke of 24".

Two American 4" two stage, centrifugal pumps, driven by sixty horse power electrical motors are used for fire protection and distribution purposes. They have a capacity of 500 gallons per minute, against a head of 125 ft., and are driven by sixty horse power motors at 1750 R. P. M.

American Well Works engineers, with their long experience in the design and specifications for pumping installations, are at your disposal.

What does ***your*** water cost per gallon?

THE AMERICAN WELL WORKS

General Office and Works
AURORA, ILL.

Chicago Office
First National Bank Bldg

EXHIBITORS' SECTION

13th Annual Exhibit

of the

Track Supply Association

Held in connection with the

42nd Annual Convention

of the

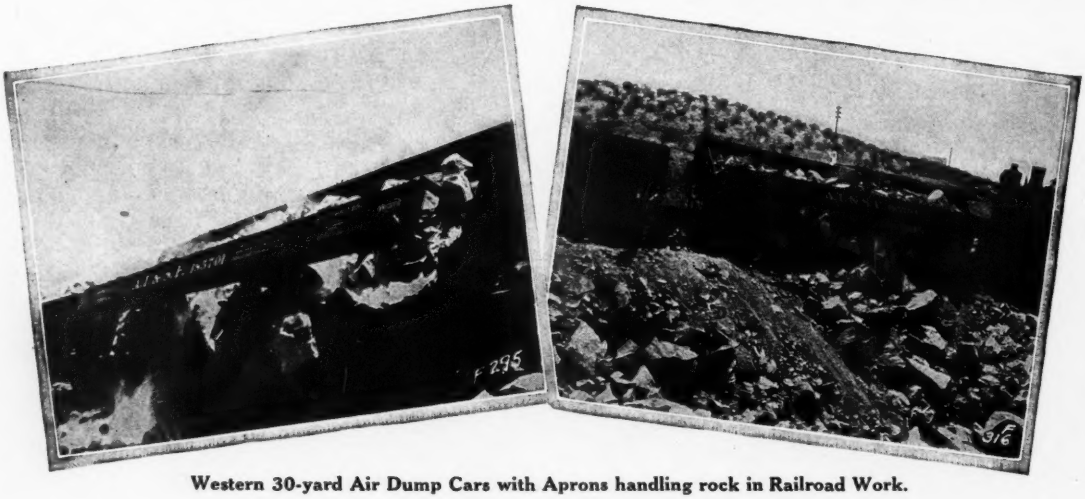
COMMODORE HOTEL, NEW YORK

Roadmasters' and Maintenance of Way Association of America

In the following special section are grouped pages descriptive of railway track supplies, equipment and materials exhibited at New York during the Convention, September 16, 17, 18, 1924.

EXHIBITORS REPRESENTED IN THIS SECTION

No Labor Loss With WESTERNS



Western 30-yard Air Dump Cars with Aprons handling rock in Railroad Work.

The Western 30-yard Automatic Air Dump Car with extension floor or apron fills every requirement for heavy railroad work.

Facts That Will Appeal

Westerns are air-dumped and air-righted.

They are Two-Way air-dump cars, with operating cylinders on both sides of car, and do not require change of cylinder or other mechanism to dump in opposite direction.

Western Cars dump either way instantly. The importance of this will be recognized at once.

The Western apron moves away from the load and the car rights instantly, without shoveling or moving up.

Built in all practical sizes for railroad use.

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Railroads installing these superb labor-saving Westerns are enthusiastic. May we refer you to them? Write today, please.

WESTERN WHEELED SCRAPER COMPANY

Founded 1877

Earth and Stone Handling Equipment.

Aurora, Illinois.

M19—INSPECTION CAR

Reasons for Fairmont Leadership and Economy

Simplified Cylinder Head

It is a one-piece casting free from any small passages or valves which catch carbon. The spark plug is located at the center to insure uniform combustion. Note the spherical shape which is ideal for economy.

Note These Figures

Time:—10 months.
Place:—Roadmasters district on Class 1 Railroad in U. S. A.
Performance:—A Fairmont "Safety-Quick" M19 Inspection Car took the Roadmaster and those he wished to carry with him (4 men maximum) on all his inspection trips. Car made 4,100 miles during the period and averaged 51.9 miles per gallon of gasoline.
Cost per car per 100 miles:

Operation	.48
Maintenance	.40
Overhead	.86
TOTAL	$1.74

Name of railroad furnished on request.

Performance on the Job Counts

Facts, Figures and Fairmont!

When it comes to choosing the right motor cars for railway service, the wise executive wants to know facts and figures. He is interested in tests; he wants to see the records.

On this fair basis of **proved performance** Fairmont Motor Cars are the choice of more than 700 railway lines, all over the country.

The Fairmont is a synonym for dependable, economical action, wherever maintenance men meet. Their own experience and observation show that, for power, safety and comfort, **at lowest cost per mile or per year,** the Fairmont amply deserves its leading place.

Among the factors which prove a high degree of engineering skill is the simplified cylinder head shown in the panel. It is an important "detail" which ranks high in mechanical achievement.

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. . . the fine thing about the Jordan Spreader-Ditcher with attachments is that it's an all-the-year-'round machine. It fights snow, rips out ice, forms ditches, slopes banks, and spreads bulk materials.

We will gladly tell you all about the Jordan. Write for full information.

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SNOW PLOW ICE CUTTER UNIVERSALLY STANDARD DITCHER
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At the Roadmasters Convention *See* these Five New and Improved Appliances—

1 New Century Switch Stands, with six improvements in design.

2 Bethlehem Hook Flange Guard Rail, a new design, (first exhibited at Chicago in March).

3 The new Bethlehem Positive Switch Stand, Model 53, for Main Line, (on exhibition now for the first time).

4 Bethlehem Parallel Throw Switch Stand, Model 1222, with several important improvements.

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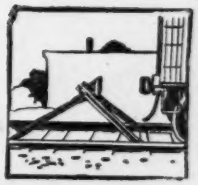
Dependability, low cost of operation and maintenance, and full power at all speeds are features constantly broadening the circle of influence of



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Free Running Engine **Friction Driven**

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AMPLE POWER FOR TRAILING LOADS

No. 19-L Heavy-Duty Motor Car with Trailer

For the safe handling of extra gangs at speeds consistent with SAFETY FIRST operation

START UNDER THEIR OWN POWER

Ratchet Jacks and Cone and Ball-Bearing Jacks

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HIPOWER is manufactured of the highest grade special electric furnace alloy steel.

Its subsequent fabrication and heat treatment is unique. The very existence of HIPOWER has made such processes necessary.

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Only by the use of such exacting methods can the uniform excellence of HIPOWER be guaranteed.

HIPOWER has established a reputation for maintaining a high standard of track maintenance at reduced cost of labor and materials.

Its proven ability to reduce maintenance costs has been demonstrated on America's greatest railroads.

Safeguard your track with HIPOWER The premium is negligible compared to cost of purchase, construction and maintenance.

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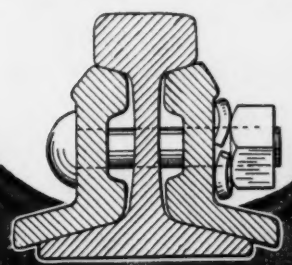

Maintains the Bolted Security of Railway Track Joints

Economy in Maintenance in a Lean Year

1,000,000 Gallons of
ATLAS "A" WEED KILLER
were used in 1924 by
28 Railroads.

Our
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Easier Tripping!

AGAIN, the genuine Barrett jack asserts its leadership. Not since the introduction, over 30 years ago, of the genuine Barrett Track No. 1, has a more notable improvement been made in tripping devices.

You cannot test or observe this jack in actual service, without being struck by its ease in tripping, simplicity and strength. *Under loads ordinarily requiring two men, one man can easily trip this jack.*

Note the location of the trip within the base, out of the way where it cannot be broken or lost. It is instantly set for tripping, and cannot stretch, bend or break, as it is in compression when tripping.

This trip cannot accidentally fall into place for tripping even when used horizontally for tie-spacing. Pawls cannot accidentally re-engage the rack, as they are locked out until trip is again in neutral.

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Established 1883

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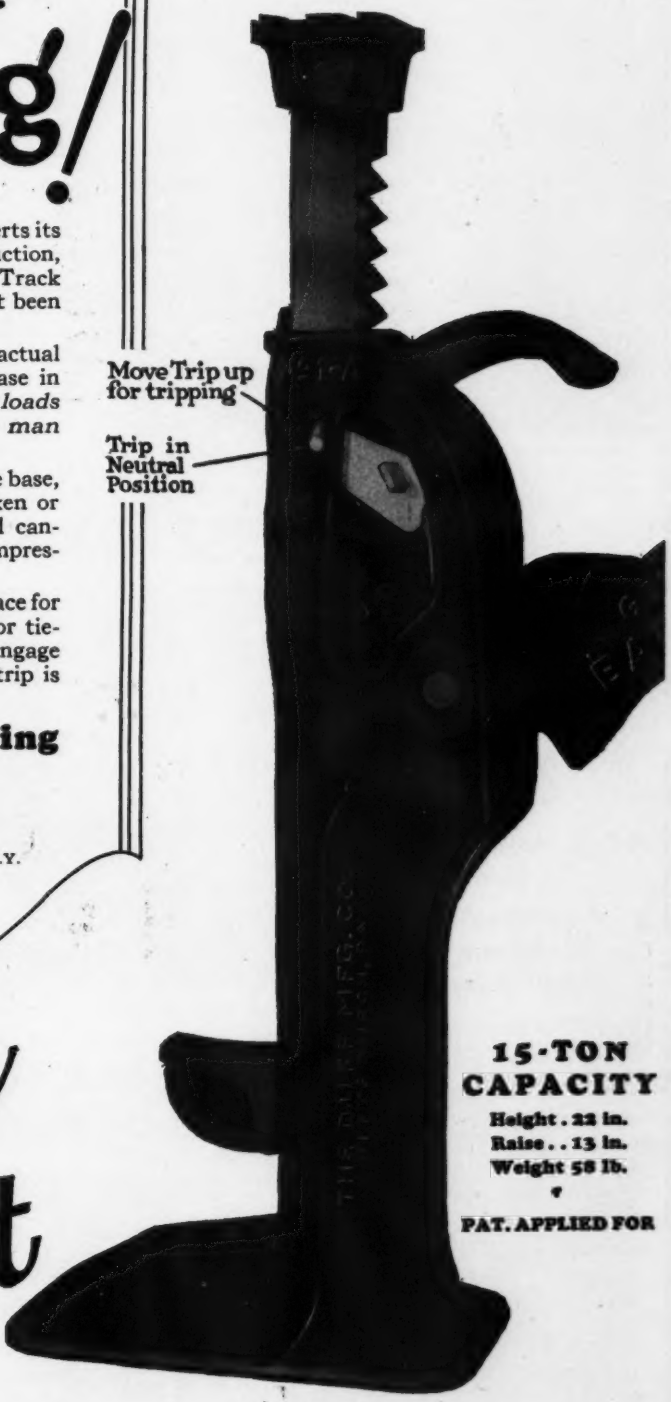


15-TON CAPACITY
Height . 22 in.
Raise . . 13 in.
Weight 58 lb.

PAT. APPLIED FOR

Genuine Barrett

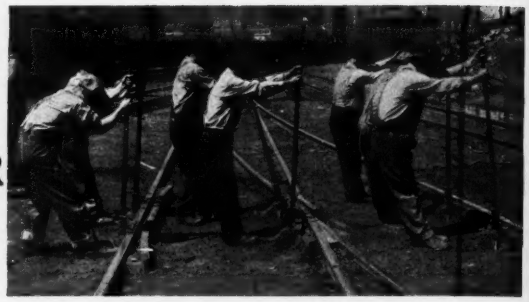
TRACK JACK no. 1-A

THE IDOL TRACK LINER

GREATEST LABOR SAVING DEVICE FOR LINING TRACK, SPACING TIES AND RAISING LOW JOINTS. NO SURFACING NECESSARY

Three men with Idol Track Liners doing work formerly requiring from seven to nine men with old method.

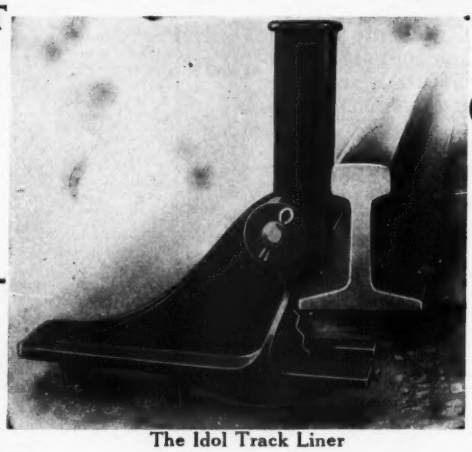
SAVE 50% LABOR COST



Seven men with Idol Track Liners doing work formerly requiring from fifteen to twenty men with old method.

NOW IN USE ON 81 RAILROADS

SEE OUR EXHIBIT AT THE 13th Annual Exhibit of the Track Supply Association and 42nd Annual Convention of the Roadmasters' and Maintenance of Way Association



The Idol Track Liner

BOOTH No. 15 COMMODORE HOTEL NEW YORK CITY

SEPTEMBER 16-17-18 —1924—

THE IDOL TRACK JACK AND TIE SPACER WILL DO WHAT ANY TRACK JACK WILL DO

With the Idol Track Jack and Tie Spacer one man can carry his whole outfit on his shoulders, Jack, Wrench, Pick and Shovel and make any ordinary repair along the line without assistants, thereby cutting down track gangs to a minimum.

THE IDOL TRACK LINER CO.

Railway Labor Saving Devices

723 South Wells St., Chicago, Ill.

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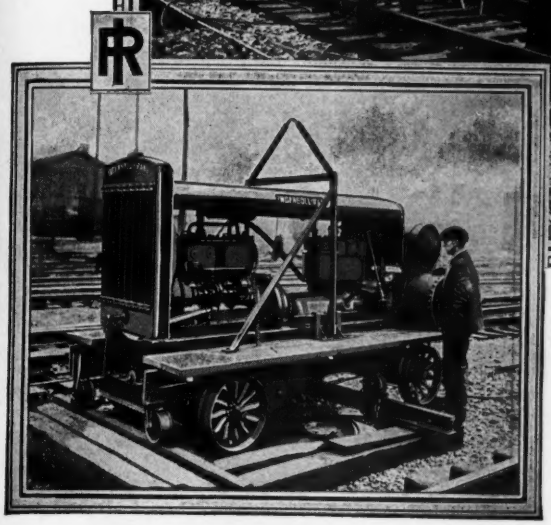
Hope E. Scott & Co., Ltd., Sole Canadian Representatives

The Baldwin Locomotive Works, Export Representatives



Above—Twelve Pneumatic Tie Tampers in use by a Ballasting Gang.

Left—Size 9x8 Type Twenty Portable Air Compressor Supplying Air for the Twelve Tampers shown above.

MORE TRACK TAMPED PER MAN OR PER DOLLAR

Actual records of track work show that with pneumatic tie tampers three to five times as many feet of track are tamped per day as by hand tamping.

The tamping is more uniform, considerably more ballast is tamped under each tie, and the ballast is tamped harder. The result is that the track is put in better line and surface in the beginning and remains so for a much longer period than is possible with any hand tamping.

Ingersoll-Rand Pneumatic Tampers not only speed up the tamping but lighten the work. Less effort is required to hold and guide the air tamper than to swing a pick or bar.

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For Canada refer Canadian Ingersoll-Rand Co., Ltd.

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PORTABLE LIGHTS

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CARBIC CAKES

"The Heart of the Carbic Light"

Carbic cakes are the most economical, reliable and time saving means of producing powerful light for portable uses. These solid, compact "bricks" slip quickly and easily into the light and burn long and efficiently. No fuss, no muss, no waste.

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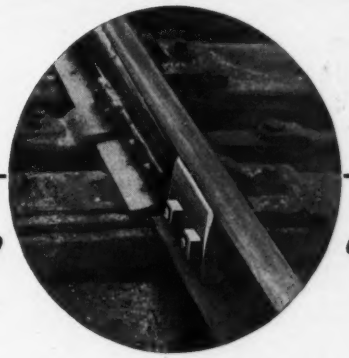
We also make Portable Carbic Generators for use in Oxyacetylene Welding and Cutting



"Mack" "Mack"

Switch Point Protector
Lowers Maintenance Costs

TO KEEP your switches in working order and safe for traffic requires constant switch point repairs and frequent renewals.

The "Mack" switch Point Protector absorbs the shock, diverts by lateral thrust the flange grind that means short life to unprotected switch points.

Records of numerous installations on several different railways have proven that switch points last from five to ten times longer with this protection.

"Mack" Switch Point Protectors are simple, inexpensive and positive in action. They not only prolong the life of the switch point, but also act as a safety device by eliminating the possibilities of derailments. They are easily and quickly installed at small cost. Their replacements can be made by one man in a few minutes.

If you desire a longer service life from your switches, lower maintenance costs and greater safety, it will pay to investigate the "Mack" Switch Point Protector.

Made of Manganese Steel—for any size rail.

Write for complete data

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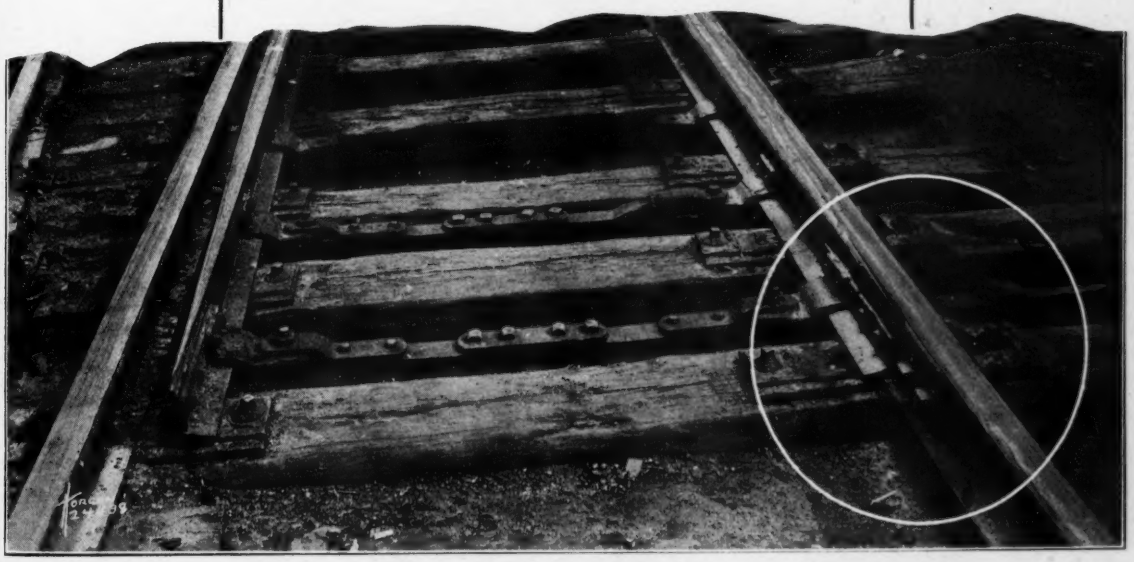

ALL STANDS IN THIS YARD ARE RAMAPO SAFETY SWITCH STANDS

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Hundreds of other terminals all over the country use Ramapo No. 20-B's exclusively.

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Other styles furnished for intermediate and high targets

"SAFETY FIRST"

One of the most dangerous [illegible] switch stand, target indicating safety. [illegible] circuit protection. The [illegible] this danger is by the use of Ramapo Safety Switch Stands.

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Also Manufacturers of RACOR Heavy Duty Heat Treated Guard Rail Clamps; Double Shoulder Rolled Switch Plates; Manganese Reinforced Switch Points; Ajax Manganese One-Piece Guard Rails; Switches, Frogs, Crossings and General Railway Track Material

Unretouched photograph of Lundie Tie Plates in service since 1914

Note remarkable condition of tie beneath plate after eight and one-half years of heavy main line traffic.

Good Ties Deserve Good Tie Plates

ARCHED upper surface—concaved lower surface and transverse bottom ribs are distinctive features of Lundie Tie Plates.

Mechanical wear that prematurely destroys costly ties is entirely eliminated by the action of Lundie Tie Plates in developing beneath the plate a hardened glazed wear resisting surface.

Track is held to rigid gauge under all conditions. All bearing surfaces being at right angles to the resultant force of the wheel load eliminates any tendency of the plate to slip.

By greatly lengthening the life of both tie and rail, Lundie Tie Plates definitely lower the cost of maintenance.

The Lundie Engineering Corporation
920 Broadway, New York
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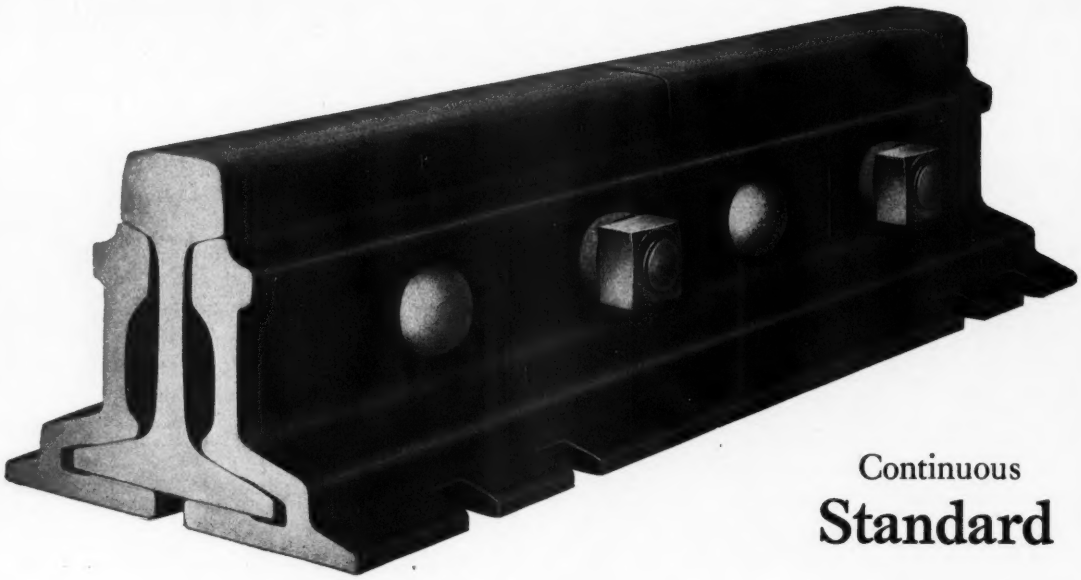
Lundie Duplex Rail Anchor—

Designed to hold firmly the rail in both directions, only one anchor per rail is required.

LUNDIE TIE PLATE



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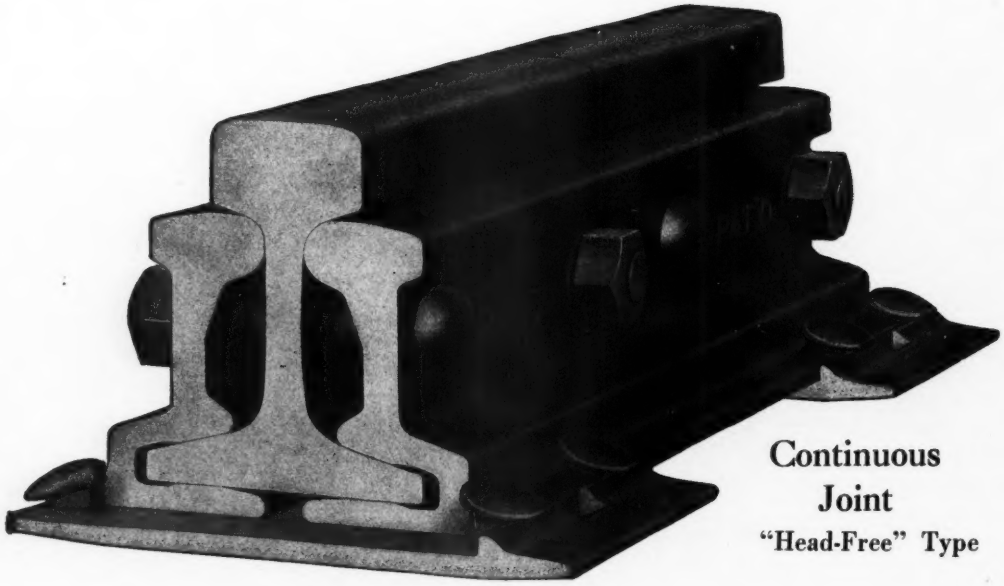
Safety—Durability—Economy



Continuous
Joint
"Head-Free" Type

The Rail Joint Company

61 Broadway New York City

Railway Engineering and Maintenance

Volume 20 October, 1924 No. 10

A SIMPLE REASON FOR AN UNUSUAL RECORD

NO development in recent years has aroused more interest among railway engineering and maintenance officers than the records which the Canadian Pacific has established in re-laying rail on its main lines. As described in the September issue of *Railway Engineering and Maintenance* this road re-laid an average of nearly seven track miles of rail per day during the season which is now closing and in one period of two days actually replaced 29.7 track miles of rail in less than 18 hours' working time with one gang of 220 men. In fact, the work has been so organized on this road that a gang is now expected to proceed at the rate of a mile of track per day for every 25 or 30 men in the gang. When such a schedule is contrasted with the progress made on the average road it is not surprising that it has created keen interest and has stimulated an investigation of the methods prevailing on more than one railway.

In comparing this record with the performances on other roads the comparison must, of course, be made between similar operations. Thus, the method in effect on the Canadian Pacific contemplates the performance in advance or immediately following the actual work of re-laying rail of a number of details which it is the practice of other roads to complete along with the replacement of the rail itself. With the inclusion of the time required for the performance of these details the contrast between the Canadian Pacific record and that of other roads is not as great as appears at first glance. However, after due allowances are made for these differences in method it is still evident that the Canadian Pacific's performance exceeds that of the average railway. For this reason it is worthy of careful consideration.

The success of this plan is a result of the thorough organization of the work in all of its details in order that no delay may occur in any portion of the work which will tend to interfere with other operations. Special attention is given to the accurate distribution of the materials in advance, to the removal of extra spikes on curves and elsewhere, to the opening of joints at intervals and the oiling of bolts in them so that the rail may be uncoupled readily, all of which measures tend to anticipate and eliminate conditions which delay the average steel gang. It has long been recognized by railways that maintenance of a moderate but uniform speed is more conducive to fast train schedules than alternate spurts and delays. The same principle applies in rail-laying operations.

Another feature which has contributed to this record is the fact that by concentrating on and pushing to completion those operations which are interfered with by the movement of trains, the delays resulting from this interference can be reduced greatly and the ultimate output increased accordingly. Studies made on one road indicate that the delay which a rail-laying gang experiences when required to close the track to let a train over approximates one-half an hour. With six trains within the working hours of the day, this delay to the gang aggregates three hours. If a gang should require eight days to complete the re-laying of a stretch of track the total loss would amount to 24 hours, or an equivalent of three full days. However, if by more thorough preparation for the actual transfer of the rail in advance and the postponement of other details until after the rail is replaced, it is actually possible to re-lay the rail itself within three days, the total delay from traffic has been reduced from 24 hours to 9 hours and a net saving of 15 hours' time effected for the entire gang, since those operations which can be done before and after rail is re-laid can be performed with relatively little interference from trains.

In brief, these records of the Canadian Pacific have

YOUR THINKING

Jim was a track-walker. He inspected the roadbed. He had to think about ties, rails, joints, nuts, bolts and frogs. If he did not think about his work something would go wrong. There might be a derailment or a wreck. The road would become inefficient. It would be his fault. The thinking of the track-walker was important.

Williams was general manager of the railroad. He sat at his desk. He had to think about income, expenses, property, supplies and equipment. If he did not think about his work something would go wrong. The road would become inefficient. It would be his fault. The thinking of the general manager was important.

If Jim, the track-walker, had stopped thinking about his work the thinking of the general manager could not have prevented an accident. If Williams, the general manager, had stopped thinking about his work the thinking of the track-walker could not have provided the payroll. Everyone's thinking was necessary.

And so it is that all in the organization depend upon each other's thinking. Everyone's thinking is important to everyone else. Your job requires thinking, steady thinking, careful thinking, real thinking—your thinking.—*American Educational Association.*

been made possible by reducing to the minimum those operations which suffer from delays by traffic and then by so organizing the forces that maximum progress may be made in the actual work of replacing the rail. These principles are not new in industry. They deserve wider application in maintenance operations.

TRAINED MEN ARE ESSENTIAL

ONE ESSENTIAL for the successful conduct for bridge and building maintenance is the development of a plan for the work to be done collectively and individually. The more complicated the job, the greater the necessity for a thorough plan. This point was stressed in particular in last month's issue in pointing out the elements which make for success in a project like the renewal of a turntable where the time element is highly important. In a case such as this the preparations include the careful instruction of each man concerning the part he is to take in the work. This, of course, is essential but it is impossible a teach a man how his work should be done at the time that such a program is being planned. This is something which he must have learned previously in the course of his employment in the bridge gang.

This is a phase of bridge and building maintenance which has an important bearing upon the efficiency of the organization in all its work. Bridge gangs are often called on to perform work in which the time element is just as important as in the replacing of a turntable but with no such opportunity for planning the work in advance. There were frequent illustrations of this during the month of August, especially in the middle western states where a period of unusually heavy rainfall with many severe storms caused numerous washouts which called the bridge gangs into a service, the nature of which is too well known to require elaboration here. In such work each man in the gang *must* know what is expected of him without any previous instructions. The answer is simple. Bridge gangs must be maintained on a basis that will insure an adequate number of men who have had sufficient experience to insure that they will have become skilled workmen.

THE ROADMASTERS OF THE FUTURE

THE CHARACTER of the reports presented at the Roadmasters' convention this year reflect the change which is taking place in the maintenance of way organization today. The variety of topics included in the reports indicates the recognition on their part of the diversity of the problems which come within the scope of track work. Reports such as that on the disposal of cinders also demonstrate the close co-operation which must exist between the work of track forces and that of other departments. Above all, the reports presented this year show the increasing thoroughness of the work of this association.

A survey of those in attendance at the convention shows an increasing number of young men, particularly from the eastern roads. It also shows that track work is becoming increasingly attractive to young men of technical education. While most of those present at the convention have come up through practical apprenticeship of laborer and foreman, a small but increasing number are college graduates who have chosen track work because of the possibilities for advancement to higher operating and executive positions.

Each avenue of training has its advantages for the young man of energy and ability. Each benefits from competition with the other. On one hand, the man of practical training is aided because of the necessity of applying himself diligently to the study of methods of organization, control of costs, etc., to meet the standards of his neighbor in this respect. Likewise, the man who has entered track work through the other channel must apply himself to the study of the practical phases of track work in order to avoid the pitfalls of inexperience.

The day when the young engineer shunned maintenance work is passing rapidly for he sees in it an opportunity for advancement to important positions in railway service. His entrance into this branch of railway work will result to its good for he will succeed only as he acquires the practical knowledge of maintenance work possessed by his neighbor while the fact that he so qualifies will make the competition for higher positions all the more keen and raise the personnel of the entire organization to a higher level. It is evident from a study of the Roadmasters' Association that this development is now under way.

THOROUGH STUDY IS NECESSARY

IT IS NOT often that the editor feels called upon to recommend the reading of articles appearing in the publication for which he is responsible. The fact that he has considered them of sufficient merit to justify their publication is ordinarily considered sufficient proof that he considers them worth reading. But there are exceptions to all rules and such an exception would appear to hold in the case of one of the leading articles in this issue which describes the method which has been applied on one road for the most extensive application of improved practices in the making of concrete.

The method described in this article has been advocated for a number of years but, thus far, has had but limited application outside of large projects on which it was possible to have the concrete mixture "designed" by the engineer in charge and checked from day to day by an assistant engineer whose duties required him to remain on the work during its entire duration. There is a reason for this. The terms, "fineness modulus," "slump test," etc., have meant nothing to the average concrete foreman. An appreciation of the foundation for their application implies technical knowledge which few of them possess while a thorough understanding of the method by which they are used entails no little study.

In spite of these formidable obstacles the engineering department of the Cleveland, Cincinnati, Chicago & St. Louis, after a thorough trial of the method on a large arch bridge in Ohio, became so thoroughly convinced of its practicability in actual use and of the resulting improvements in the uniformity of the quality of the concrete that it is now applying it to practically all concrete construction on the lines of that road. Experience has shown that after the method has been thoroughly mastered and applied, the routine operations which must be carried out from time to time during the course of the work are relatively simple. The mathematics involved are a matter of a few simple calculations in arithmetic and take but little time.

The stumbling block in the adoption of the improved practices lies in the seeming reluctance of the railway

engineer to dig into the subject and learn what it is all about. It is also true that some of those who have had the hardihood to study this problem have given up in discouragement for the reason that previous expositions of the method have not entirely bridged the gap between laboratory conditions and practical construction work. This was discovered by J. B. Hunley, bridge engineer of the Big Four, who applied the methods on that road, but his studies have cleared up these perplexing differences and the outline of procedure which he has developed for those in charge of concrete work on that road places the matter on a strictly practical basis.

The article as presented is divided into three parts. The first comprises an outline of the condition which led the engineers of the Big Four to look for some practical method of improving the quality of the concrete. This is followed by an explanation of the method and by a typical example of the manner in which the method is carried out step by step in practical work on the railroads.

NOBODY DOES ANYTHING ABOUT IT

MARK TWAIN is credited with the remark that while everybody talks about the weather nobody ever does anything about it. Much the same condition prevails with reference to the alternate "hiring and firing" of maintenance of way employees and particularly in regard to the drastic reductions in forces which are made on most northern roads at the approach of winter. The evils resulting from these periodic drastic curtailments in forces have been the topic of discussion among track men for generations. Committees have prepared reports and they have been discussed actively. Another report is presented by the Roadmasters this year. However, no one has yet made a sufficiently detailed and accurate study to demonstrate to the satisfaction of the managements of the railways that the practice which has prevailed so long is uneconomical. What is needed is less discussion of this subject and more real facts on the actual difference in cost involved.

It is one thing to state that the present practice of laying off a portion of the force during the winter months is uneconomical. It is another thing to present a program of work which these men can do during the winter to advantage in sufficient detail to demonstrate that they can and will be kept employed constructively and that the work so done will relieve the summer load to that extent. Before such a program can be presented with any degree of accuracy it is necessary that an analysis be made of the time actually spent during the summer on those operations which can be performed to advantage during the winter months.

Such a study will show the extent to which the performance of these various duties in the winter will warrant the retention of men who would otherwise be laid off and decrease the demand in the summer. An officer of one western road made such a survey of the actual painting program of the forces on his road a short time ago and found to his surprise that a sufficient amount of the painting work could have been done as well during the winter as it had been done during the preceding summer to have kept 40 per cent of the summer force busy throughout the winter, whereas this force was practically disbanded. A similar study of the actual time spent on other maintenance work may develop similar conditions. It would at least provide the information on which decisions can be made more intelligently.

Such a survey should place values on the added efficiency of permanent employees, measured in output of work, on the extent to which all-year-round work will hold efficient employees in service and other important influences. Other incidental advantages, such as having larger forces available when needed to combat storms, as contrasted with the recruiting and caring for men to meet such special emergencies, should also be considered. Offsetting this should be charged the losses due to adverse weather, etc.

The net result of these tabulations if they are made accurately, should show whether the employment of more men during the winter is economical. Without such information any report or any decision is only as accurate as the judgment behind it is sound.

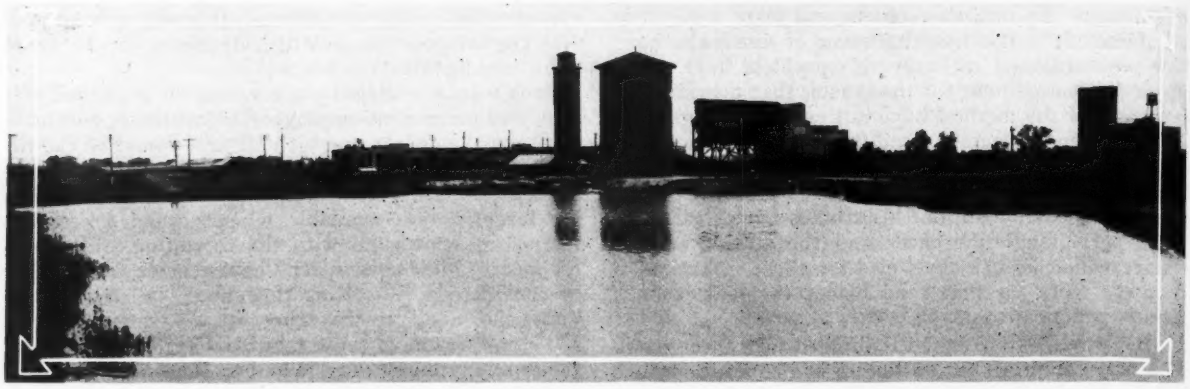
NEW BOOKS

Marine Structures, Their Deterioration and Preservation. By William G. Atwood and J. A. Johnson, 534 pages, 169 illustrations, 6 in. by 9 in. Bound in cloth. Published by the National Research Council, Washington, D. C. Price $10.

This volume represents a compilation of the information gathered, correlated and analyzed during the last 2½ years by the Committee on Marine Piling Investigation of the Division of engineering and Industrial research of the National Research Council in an effort to solve the problem of protecting piling and other timbers from the ravages of marine borers and other forms of construction from the deteriorating action of sea water. This committee was created following the disastrous attacks of marine borers in San Francisco bay from 1917 to 1920. While, therefore, the study of the committee was concentrated largely on the crustaceans and mollusks which attack wood, considerable thought and research was devoted to the service rendered by materials substituted for wood in marine structures.

The work of the committee has been given previous publicity in the form of rather exhaustive progress reports and a considerable part of the present volume is of this nature, being devoted to a compilation of valuable data on the service records being obtained with timbers in a large number of widely scattered ports along the entire American seaboard. However, a section of about 200 pages of the volume consists of a summary of the entire research to date and this, without doubt, comprises the most up-to-date and authoritative analysis of the entire subject available at this time.

It includes detailed descriptions of various forms of animal life responsible for the injury done to wood submerged in sea waters, their physical nature, life processes, geographical distribution and activity in destructive work. It also reviews the results obtained with various wood preservatives, and the service obtained with the so-called immune woods, as well as protective measures by armoring or sheathing the wood with materials that prevent the entrance of the various forms of animal life. These discussions are followed by a review of the service rendered by the substitute materials. A general summary which evidences a commendable lack of bias outlines the conclusions which have been reached as a consequence of the studies made.



The Present Water Supply Facilities at Council Bluffs, Including a 35,000 gal. per hour Softener and Large Storage Tank

Union Pacific Water Improvement Work Proves Profitable

Investigation Develops Significant Facts About Long Locomotive Runs. Firebox and Flue Records Striking.

THE UNION PACIFIC has attracted considerable attention in the past two or three years by its work in developing long locomotive runs. The first step in this direction was taken in March, 1921, when the passenger run between Council Bluffs, Ia., and Cheyenne, Wyo., a distance of 509 miles, was reduced from four engine districts to three, with one run of 225 miles. It was only slightly more than a year afterward when, on June 1, 1922, Engine No. 7000, a coal burner of new design, only a few hours after completing a fast trip of 281 miles with a 2,481-ton train of refrigerator cars, left Omaha with a passenger train of 12 steel cars, hauled it up-grade 509 miles to Cheyenne, Wyo., without delay, and left a few hours later with an equally heavy train which it hauled 484 miles to Ogden, Utah, arriving within one hour of schedule time, notwithstanding ruling grades of 1.55 per cent at numerous points. This performance was followed by a series of equally and in some cases more spectacular runs elsewhere on the system, until by July 3, less than five weeks from its initial trip, this engine had run fully 10,000 miles or at the rate of 300 miles a day. A few months later a sister engine, the 7016, started from Council Bluffs, Ia., with a mail and express train of 12 steel cars and hauled it at the scheduled average rate of 45 miles per hour, including stops, for the entire distance of 992 miles over the continental divide to Ogden, and increased the figure to 1,984 miles by making the return trip with the next passenger train. Thus by rapid strides the Union Pacific progressed until at present it is the established practice to make the following passenger runs east of Ogden without changing engines:

Kansas City, Mo., to Denver, Colo., 644 miles.
Cheyenne, Wyo., to Pocatello, Idaho, 551 miles.
Denver, Colo., to Ogden, Utah, 577 miles.
Council Bluffs, Ia., to Denver, Colo., 562 miles.
Council Bluffs to Cheyenne, Wyo., 509 miles.
Cheyenne to Ogden, 483 miles.

In addition to the passenger runs the former freight engine runs have been doubled by making one district where there were two before, a program which gives the Union Pacific the distinction of operating the longest coal burning passenger run on record and the longest number of runs of similar extent.

The interest aroused by these long locomotive runs has arisen from their far reaching effect on railway operation. Attention has been called to the marked savings immediately accomplished in the number of locomotives required to produce a given number of train miles. It is reported that no less than 70 engines have been released for other duties while for all runs the reduction is said to equal 25 per cent of all locomotivs assigned. Estimates have also been made of considerable savings in enginehouse expense, running repairs, and fuel. Included in the savings are also those that result from the marked increases in the available mileage of engines per day, the saving in wages for train crews, etc. It has even been asserted from the results so far that locomotives will run longer between shoppings for firebox and boiler repairs through the maintenance of more uniformity in heat, and that decided advantages flow from the concentration of work in fewer places, while the institution of long locomotive runs on the Union Pacific is also said to have dispensed with the need of large expenditures for enlarged terminal facilities, notably the immediate expenditure of several hundred thousand dollars at Rawlins, Wyo., and Grand Island, Nebr.

Long Runs Significant

But the long runs on the Union Pacific have also served to arouse an interest in the work which has been done in connection with the water supply. The Union Pacific grew up with a water problem. When General Dodge received his commission from President Lincoln to construct the road, one of his first and continuing problems was to provide water supplies in a territory where water was none too plentiful. The outcome of this was that many of the waters obtained were not of the best, particularly on the plains east of the Rockies. However, no trouble of consequence from this source has been encountered in the long locomotive runs. Engine 7016, which made the run from Council Bluffs, Ia., to Ogden, Utah, and back, is

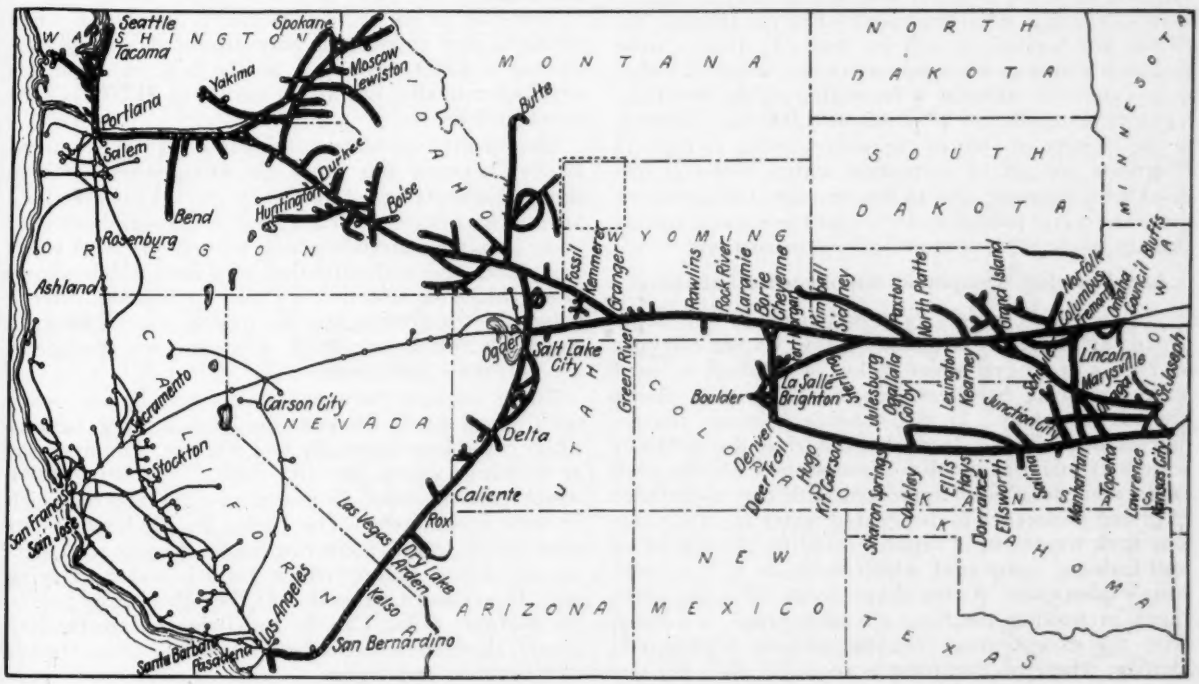
reported as having completed the trip without foaming in spite of the fact that no boiler compound was used throughout the trip and that the boiler was not washed out at Ogden! In no case has trouble from foaming or dirty boilers been reported on any long passenger run since the runs were inaugurated! It is also significant that as the development of these long runs proceeded, the number of relief engines has been reduced until at present it is the practice on the Omaha-Cheyenne line, for example, to keep only one on hand, to protect from 18 to 20 trains a day. The effect of such observations is to attach a new importance to water improvement programs and especially to arouse an interest in the work which the Union Pacific has done in this direction.

Early Water Treatment Branded as a Failure

Water improvement work has had a checkered career on the Union Pacific. From an early date it was customary to use some form of boiler compound. problem must be found. The poor quality of the supply was continually blamed for various troubles incident to the operation of trains. Engine failures and aggravating delays were frequent. With the added requirement of developing new supplies confronting the road and the now fully appreciated need of using some judgment in their selection to avoid as far as possible waters unfit for use, it was agreed that a systematic program of improvement work should be undertaken.

Water Work Organized

The policy adopted was in general to attack the problem in three stages: First, after making a general survey with the assistance of a chemist, to give first-aid treatment wherever troubles were found, advising prompt attention; next, to get better water supplies, and, third, to perfect earlier improvements so as to put the work on a permanent basis. It was found that some of the plants were suffering from lack of compe-



A Map of the Union Pacific Showing t he Location of Water Treating Plants

In 1903 the road undertook a program of roadside tank treatment when it authorized the immediate construction of 25 treating plants, the largest order for such equipment ever placed up to that time and only equalled once since. By the end of 1904 the Union Pacific had 35 treating plants in operation. But the popularity of the installations was short lived. First one and then another facility was discontinued until in 1916 only 15 of the original plants were in use, the remainder being either dismantled or serving only as additional storage for roadside supply. However, on the Kansas division, between Kansas City and Denver, where the natural waters were particularly bad, the treating plants, while not living completely up to expectations, had given a reasonably good account of themselves. There was a belief in some quarters also that the plants were not being operated to the best advantage. Furthermore it was becoming apparent, with the growth of traffic, that some solution of the tent care and supervision, others were not properly fitted to the location, but particulearly it was found that when installing these plants future requirements had been under-estimated, as a result of which numerous plants were being operated beyond their capacity. At Grand Island, Neb., for instance, a terminal point between Council Bluffs and Cheyenne, the capacity of the treating plant was but 10,000 gallons per hour, affording a maximum efficient daily treatment of 240,000 gallons if the plant was operated 24 hours a day. Yet in 1913 the water requirement at this point was 593,000 gallons per day and is now as high as 1,000,000 gallons per day. The situation at Julesburg, Colo., affords another striking example where, notwithstanding the bad water, the capacity of the existing plant was only 8,000 gallons per hour.

Among the first remedial steps taken was to shut down one of the 15 existing plants still in operation and to restore two of the plants that had been lying

idle. There was also some shifting of the plants to new locations along with the installations from year to year of new facilities, until at present a total of 33 treating plants are in operation, including the plants built prior to 1916, which have been reduced in number to 17. This does not include 8 plants on the lines west of Ogden.

The division on the Union Pacific which is most completely equipped is the Kansas division, including the main line between Kansas City and Denver where there are 12 plants, not counting treating plants at Marysville, Kan., and Onago, junction points on the crosslines between the Kansas City-Denver line and the Council Bluffs-Cheyenne line. This is not a line of the most heavy traffic, but carries a very considerable tonnage and is the region of the worst water from the combined scaling, pitting and foaming standpoints. By referring to the chart, which gives the average hardness of the natural water at all stations, the amount of alkali or foaming salts and the amount of sulphate hardness together with the amount of incrustants remaining after treatment wherever treating facilities are located, it will be seen (1) that a wide variation exists in the qualities of the water (2) that in no case is the amount of incrusting matter less than 8 grains per gallon or 1 1-7 lb. per 1,000 gal., (3) that in the vicinity of Denver the water carries as high as 75 grains per gal. of incrusting matter alone at one point with foaming salts to the amount of 30 grains or more at several points, and (4) that the natural waters average about 20 grains per gal. of incrustants.

Anti-Foaming Compound Supplements Softeners

This water is largely of a carbonate or soft scale producing character with only a few waters carrying an excess of 10 grains per gallon of sulphate or hard scale producing hardness, but the 12 treating plants are not too many. In the absence of more, the requirement is obviously of harmonizing the different waters as much as possile. Consistent with this plan enginemen have been impressed with the importance of giving preference to designated water and the roadside tank treatment is supplemented by the use of an anti-foaming compound which is made in the company's laboratory. As the chart shows, all of the water taken in making the long locomtive runs is treated with the exception of four points, one of which is Denver, where no treatment is required, and only one of the other three points of which is very bad. This water is often avoided in making the runs.

Of the remaining plants, seven are distributed along the line between Council Bluffs and Cheyenne, three on the lines north out of Denver, and one at Granger on the line between Cheyenne and Ogden. This is not many plants for this section, which is the territory of heaviest traffic, being double tracked throughout with as many as 18 passenger trains per day, but the plants are situated where operation is considered productive of the most benefit (all coal taking points), and constitutes one important element of the work carried on in this region.

Water Treatment Only One Feature

It should be emphasized, however, that the installations of these facilities was only one part of the work done. As a matter of fact a plant that had been in use at Cheyenne was removed, the city of Cheyenne having developed a water supply which required no treatment. An old and inadequate treating plant at Grand Island was also removed as an incident of a development carried out there where the driving of two new wells and the installation of electrically driven centrifugal pumps not only produced a water carrying only 8 grains of incrustants as compared with the 21 grain water of the old steam operated wells but also increased the supply from 350,000 gal. to 1,000,000 gal. per day and at cost of only two cents per 1,000 gal. as compared with the former cost of six cents per 1,000 gal., which is equivalent to a saving in operation alone of $40,000 per year on the basis of present consumption. At North Platte, one of the most troublesome water points on the line, an open well supply was replaced by a river supply and a steam plant by the installation of two electrically-driven centrifugal pumps, producing a water carrying only 12 grains of incrustants in place of 21 grain water and at a 60 per cent reduction in cost. At Ogalala a similar change brought in a water with only 13 grains of total solids as compared with the former water which carried 89 grains of total solids, of which 51 were of an incrusting nature. Again at Council Bluffs, a new supply not only produced a supply affording a $3,000 reduction in the cost of chemicals required annually, but also a saving of $12,000 a year in water bills.

The quality of water obtainable on the Council-Bluffs-Cheyenne line since the completion of these changes is represented by the chart. As a whole they are still hard waters but are generally low in both hard scale forming materials which with the several treating plants and a distribution of water which allows some choice in selection for the enginemen, offer a reasonable protection against trouble except between North Platte and Julesburg. Here it is the practice to use anti-scale compound.

Trains running between Omaha and Denver leave the Council Bluffs-Cheyene line at Julesburg, beyond which were four especially bad waters. The first was at Sterling, where the city water was being used, which carried about 45 grains of minerals, of which 35 were incrustants. The Union Pacific now has its own supply at this point consisting of wells with electrically-driven pumps which furnish water carrying only 14 grains of mineral. At the other three points, Ft. Morgan, Colo., LaSalle and Brighton are treating plants, the last two also serving the line from Denver to Cheyenne and Ogden.

Filters For Muddy Waters

Conditions on the line west of Cheyenne were improved by abandoning the original supply at Green River, Rawlins and Rock River, and getting new ones by building pipe lines to rivers, the pipe lines in each case being about 17 miles long. While this was an expensive undertaking it produced a much better water except for mud encountered at Green River and Rawlins, which was overcome by installing gravity sand filters. To improve conditions further in this region, the supply at Carter, in the vicinity of Ogden, was discontinued and the practice instituted, temporarily at least, of hauling water from Spring Valley, about 5 miles distant, where the water is also obtained from a river.

For these improvements $1,089,000 has been expended for additions and betterments to water stations, in the eight years since 1916, or a total of $3,330,000 since 1903. The largest portion of this expenditure, however, was made for other work than

water conditioning, i. e., for increasing existing supplies by building new pump houses, pipe lines, reservoirs, and larger tanks, to meet the increasing demands of traffic. For conditioning alone the expenditure has approximated $500,000 since 1916, including the investment in existing treating facilities which amounts to about $350,000.

There is also to be considered the expense involved in the operation and upkeep of the special conditioning facilities and for the cost of compound used. The annual cost of labor for operating the treating plants varies considerably. At some places the plants are operated by coal chute men which allows a division of expense while at other places, as where city water is used, the entire time of pumpers is necessarily charged to the softener. It is estimated that the present labor charge is $19,900 a year, while the cost of chemicals amounts to $31,300 per year. But this expenditure is small in proportion to the results that have been accomplished.

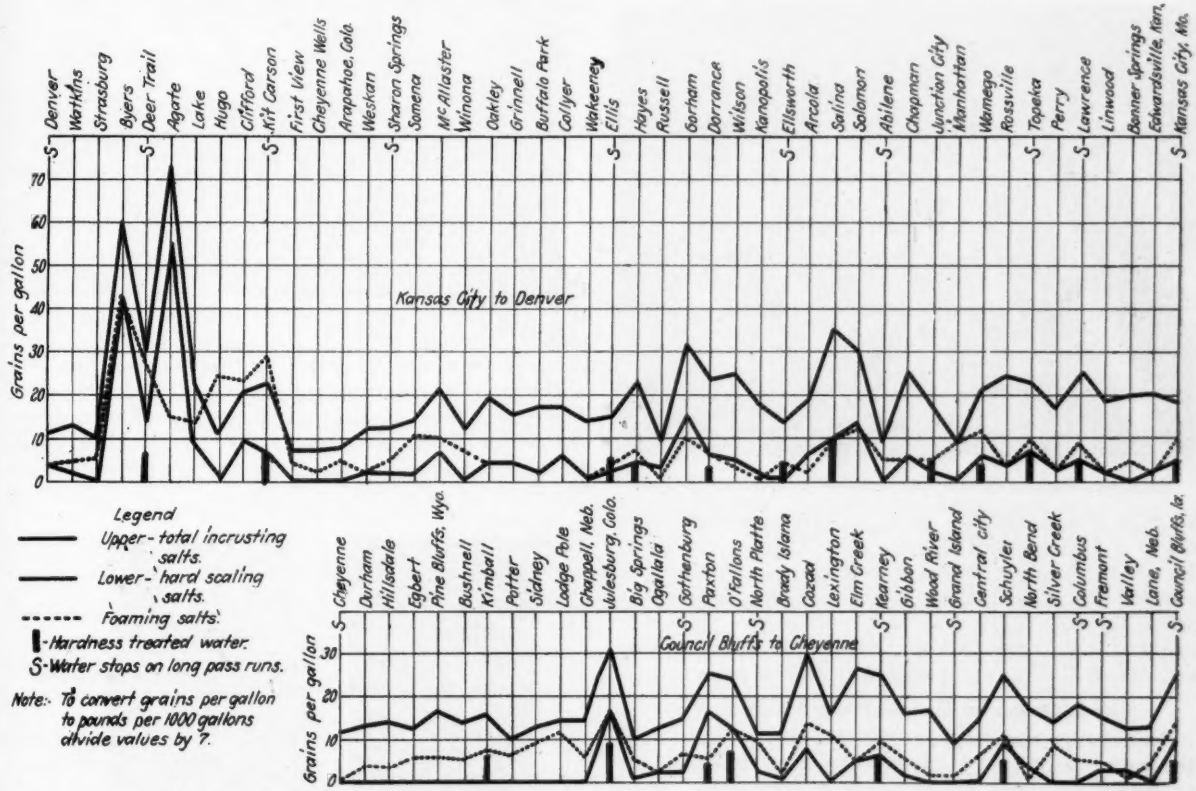


Chart Showing the Condition of Water at Stations on the Line Between Kansas City, Mo., and Denver, Colo., and Between Council Bluffs, Ia., and Cheyenne, Wyo.

Saving From Softeners Exceeds $200,000 Annually

Unfortunately the full benefit from a water improvement program over a system can never be ascertained. This is especially true in the case of the Union Pacific where the improvement has been gradual in progress and scattered and where at the same time changes of other kinds have been made on the road which have contributed to the general improvements that have taken place, including the installation of hot water boiler washout systems at several terminal points. The Union Pacific moreover has given practically no study to the development of precise figures of the savings likely to follow or actually made.

The common method of determining the value of water treatment itself on railroads is to set a money value on each pound of scale forming matter which the treating plant is calculated to have prevented from entering the boiler. In 1911 the American Railway Engineering Association had a series of tests begun at the University of Illinois with a locomotive using feed water of different degrees of hardness, from which it was concluded that every pound of scale-forming matter removed by treatment could be conservatively taken to represent a flat saving of seven cents.

This figure has since been raised to 13 cents to conform to present prices of labor and fuel. It is found that 933,120,000 gal. of treated water was consumed in 1923. This consumption is reported to have accompanied by the removal of 3,700,000 lb. of scale, but for estimating purposes, let it be assumed that the scale removed is 2,500,000 lb., arrived at by taking the average hardness of the untreated water at 25 grains and that of the treated water at 7 grains. This, on the basis outlined, is equivalent to a gross saving of $350,000 or a net saving of $250,000 after deducting $100,000, the estimated annual cost of operation, maintenance and depreciation. Thus by this method the saving per year from the water treating facilities alone is equal roughly to about 75 per cent on the total investment to date in these facilities.

A more graphic and accurate picture of the results is obtainable when a study is made of the experiences of the Union Pacific with fireboxes and flues. In this connection, reference is made to the record of the life of the first fireboxes in each of 13 Class 200 engines

put in service in 1906 on the North Platte district where some of the most troublesome waters were encountered.

This record shows that in no case did a firebox last over 23 months and that the average was as low as 17 months. In contrast the average life of fireboxes on this district is now about 49 months, without any change in the kind of material used.

Considered on a mileage basis instead of a calendar basis, the record for all districts is as follows:

Mileage of fireboxes renewed in 1916	188,060
Mileage of fireboxes renewed in 1923	284,599
Percentage increase	50

When the number and also the percentage of firebox renewals for each year are compiled and proper adjustments made for irregularities, it is found that the per-

Staybolts from a Boiler at North Platte, Neb., in 1904

centage of renewals for the eight years since 1916 was 6.8 as compared with 10.6 for the 10 years preceding. Every compilation shows a reduction in firebox renewals which logically assumes a larger significance when the increase in the amount and size of power is taken into consideration, the records showing 1008 engines in 1923 as compared with 660 in 1908.

Increase in Flue Mileage Marked

As between fireboxes and flue records the latter are the more striking. Probably the best index of the extent of the improvement in flue life is the record of purchases made over a given period. In 1917 the Union Pacific, confronted with rapidly increasing prices, bought a two-years' supply of boiler flues on the basis of the average consumption at that time. Subsequently only a very small number of flues were bought to take care of certain special needs; yet in 1921, after four years, the road still had sufficient flues on hand to last two years more on the basis of the consumption at that time, a condition which is attributed in large part to improved water.

Mention has previously been made to the bad character of the water at North Platte, Neb. Before the water was changed the flues in the switch engines at this point, which are operated 24 hours a day, was only 7 months while the average time between renewals is 30 months under present conditions, or four times as long, although the same kind of flues are used now as before. The former average for the switch engines at Grand Island is given as 8 months while an average of 36 months is reported since the new water supply was obtained.

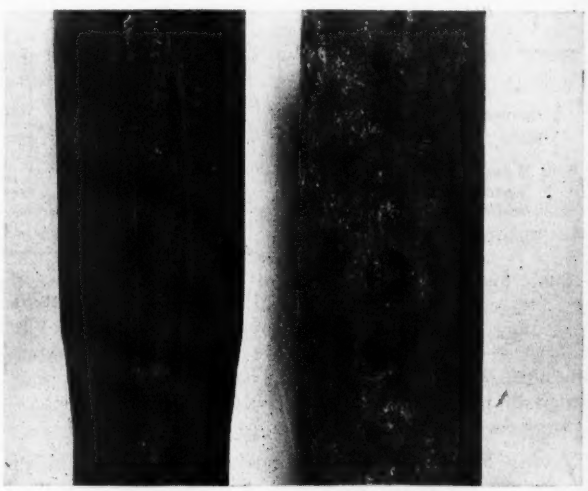
The flue record of locomotives chosen at random and from the boiler records of 1916 and 1923 dealing only with those cases where complete changes of flues were made, show about double the life in the freight engines considered and a much greater difference in the passenger mileage, all of the passenger runs listed having a flue mileage in excess of 140,000 miles and two with a mileage in excess of 220,000. The representative character of these figures is corroborated by more detailed records, particularly a compilation made of the average flue mileage for each class of engine owned in 1914 which shows the majority of all freight engine averages running below 35,000 miles and only one passenger engine with a mileage exceeding 100,000—and that a small engine.

The average mileage and renewal periods for all locomotives from the date of application of a set of new flues (new, and pieced and re-set) until they were removed is reported as shown in the accompanying table.

Comparative Flue Averages

	—Passenger—		—Freight—	
Year	Miles	Months	Miles	Months
1914	62,433	11	41,674	14
1921	98,112	16	54,963	17
1923	142,246	16	60,446	18

In this table the figures are given for 1921 to avoid the long locomotive run practice, as it appears that the lengthening of locomotive runs is having a decidedly beneficial effect in lengthening the life of flues through reducing the straining that results from less uniformity in operating conditions. It is improbable, however, that the increase in average flue mileage shown for the two year interval is attributable entirely to the long runs as most of the engines are not as yet involved in such runs. It appears rather that the



A Bagged Flue from Mud Burn and a Pitted Flue Showing Effect of Corrosive Waters

averages given for 1921 are not truly representative of conditions. But nevertheless they show a 50 per cent increase in passenger flue mileage and about a 40 per cent increase in the freight flue mileage for the entire territory, although in some sections, particularly in Western Nebraska, pitting conditions are still bad.

In connection with the flue study, it was also noticed that flues are now running from one general

shopping to the next general shopping, whereas formerly the bottom half of flues had to be changed every five or six months to keep the locomotive out of the shop until necessary for machinery repairs. It is found that engines are now marked good for 15 months' service before shopping as compared with 9 months before, while running repairs for flues are now about 40 per cent less than before water conditioning. The reputed effect of feed water heaters is not involved in determining the causes of increased flue life on the Union Pacific as there are none in service at present.

A Portion of the Laboratory at Omaha Where the Waters Are Tested

Engine Failures Reduced

The records of engine failures for 1916 and 1923 are given in the accompanying table, both for all districts and for one of the districts which was most troublesome.

	North Platte District		All Districts	
	1916	1923	1916	1923
Total failures	149	57	1662	479
Flue failures	42	8	277	51
Boiler and firebox	37	3	213	35
Per cent	53	20	30	18

Thus of 149 engine failures on the North Platte district in 1916, 79 or 53 per cent were flue or boiler and firebox failures while of 57 failures in 1923, the flue and firebox failures were only 11 in number or 20 per cent of the total. The percentage of firebox failures to the total on all districts decreased from 30 per cent in 1916 to 18 per cent in 1923.

The flue failures per thousand engine miles were as follows:

1917	0.0127
1923	0.0019
Reduction	85%

The significance of the records of actual reductions in engine failures is sufficiently obvious to require no elaboration as effecting the strike period, when the Union Pacific, like other roads, was handicapped to the point of neglecting much of the usual attention given to power, but they assume a new importance when consideration is given to the growth of traffic on the Union Pacific. There has been a steady and marked increase in traffic as well as tonnage in 1923, the gross ton miles showed an increase of 400 per cent over that for 1904 and the passenger train car miles an increase of more than 200 per cent, while the tonnage increase from 1,005 ton per train to 1,662 tons. With only slightly more mileage of line for this tonnage it is manifest that any factor contributing to reduce delays and failures is not without value.

Of all the benefits of water improvement work, the most elusive is perhaps that of determining the saving in fuel. It is a common practice to assume from a variety of experiments which have been conducted that one-eighth of an inch of scale in a boiler represents a loss of 15 per cent in fuel. In view of this the removal of 3,700,000 lbs. of scale forming matter from Union Pacific water in 1923 by water treatment, as compared with 1,500,000 lbs. in 1917, to say nothing of a considerable reduction in scale by the proper use of boiler compounds, is significant.

Likewise it is futile to attempt any exact determination of the effect of improved water on tonnage, owing to the great change that has taken place in the type of power, particularly in the handling of freight trains, as well as the marked mechanical improvement which has been made to the end of increasing the efficiency of the power plant itself. But again it is believed on the Union Pacific that some of the increase is attributable to better water conditions for the reason that engines can be operated with heavier tonnage without trouble resulting or from the danger of leaky flues, injector trouble or the impediments on steaming power of a badly scaled boiler in those cases where an engine is working closely to its maximum output.

Improved Water Indispensable For Some Long Runs

Attention has already been called to the long locomotive runs and the inference left that the success of these runs attests to the improvements which have been made in water conditions. In the case of passenger runs, it is a fact that many of the worst waters are avoided. There is no overlooking the conspicuous absence of trouble, chiefly foaming, that is met on these runs, as compared with the trouble of earlier years on less severe runs, particularly in freight service, as well as the less frequent shopping and terminal attention required; also that it is the prevailing water conditions that have controlled in the decision not to lengthen freight runs between Cheyenne and Ogden. There is basis, therefore, for the prevalent opinion on the Union Pacific that while the water improvement work was by no means indispensable to all of the long locomotive runs, even those on the plains, it is indispensable to some and is unquestionably beneficial to the others.

Organization Important

The organization charged with the chemical aspects of the water work comprises first, the consulting chemist, who is on the staff of the general manager and has charge of the company's chemical and physical laboratory at Omaha where he is also the engineer of tests. On the staff of the consulting chemist are four traveling chemists who are charged with the periodical inspection of treating plants. It devolves upon these men also to conduct various investigations in the field, to run down reports of trouble and look to their correction, and to ride engines in order to observe the behavior of the various waters and the nature of the results being obtained. In addition to these duties, they are also charged with the responsibility of checking up the use made of boiler compound. Periodical reports showing the number of engines, the amount of water taken and the amount of compound

used are received by the chemists for their assistance in determining whether or not it is properly used. Experience has established the importance of this supervision in the use of boiler compound.

As an additional check upon the treating plant operation, samples of water are shipped to the laboratory once a week for analysis, on the treated water and at longer intervals on the untreated water. The plant attendants, who are on the divisional pay roll, make daily tests of the water and are required to fill in a daily report blank showing the tests, time of treating, the amount of chemicals used together with the amount of stock on hand, any memoranda of repairs needed, etc., copies of which are furnished the consulting chemist, the divisional water service foreman (who is on the staff of the division engineer), and the traveling chemist in that territory. The engineering department keeps the record of the cost of plant operation and maintenance.

The softeners are all of the continuous type with steel tanks extending to the ground. Special care has been given to provide ample settling time for all conditions and otherwise to design each facility to meet local conditions. In view of the growing tendency toward over-treatment, it is interesting to note that such treatment is not followed nor allowed on the Union Pacific. Indeed, random analyses suggest that slight under-treatment is prevalent, but until the number of treating plants is increased this practice lends itself better to the harmonizing of treated with untreated waters. When over-treatment was practiced, injector trouble was frequent.

To Overhaul Los Angeles Line

In view of the success had thus far in water treating work, the company plans to conduct future work along lines similar to that followed up to the present, correcting the worst spots first and gradually putting conditions on a permanent basis.

The principal work of the immediate future will be done on the 784 miles of line from Salt Lake City, Utah, to Los Angeles, Calif. This is one of the worst water districts on the entire system, with many of the waters containing 30 or more grains of incrusting minerals, with a number carrying more than 15 grains of foaming salts and one water containing as much as 50 grains of this material. As a corrective measure, treating plants are already installed at six points, which, with the general use of anti-foaming compound under proper supervision, is providing a decided help, a long passenger locomotive run of over 460 miles now being made regularly on this line. Authority has already been issued, however, for a general overhauling of this line immediately, both as regards water conditioning and water supply additions. With the completion of this work, which is largely that of finding better quality water, the Union Pacific will have in operation 45 treating plants on the system, and it is expected that this district will afford the most striking object lesson in the beneficial effect of water improvement work on the system.

An Unusual Concrete Bridge

THE PHOTOGRAPH at the bottom of this page illustrates an open spandrel arch bridge of unique design built by the Louisville & Nashville on the Cumberland Valley division in connection with second-track work recently completed. The structure comprises two 50-ft. parabolic arches supporting a reinforced concrete trestle having a total length, including approaches, of 237 ft. It contains 3,200 cu. yds. of concrete. Reinforced concrete was used throughout with the exception of two mass abutments.

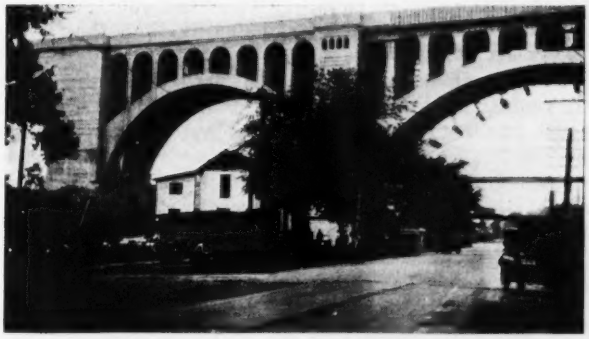
As seen in the drawing the trestle construction over the arches consists of a flat slab spanning longitudinally between transverse beams supported on columns which rest on the arches, while in the two approaches the slabs span transversely over four lines of longitudinal girders. Expansion joints were provided at each abutment and over the ends of the arches. The design was carried out under the direction of J. M. Salmon, bridge engineer of the Louisville & Nashville, and the construction under the general supervision of G. R. Smiley, chief engineer, construction. W. H. Courtney is chief engineer. The bridge was built under contract by Davis & Graham, general contractors, Pineville, Ky.

General View of the Structure

How the Big Four Proportions Concrete

Detailed Instructions Provide a Relatively Simple Procedure for the Application of Scientific Methods

FEW RAILROADS have taken a more prominent part in the development and application of concrete to railway purposes than the Cleveland, Cincinnati, Chicago & St. Louis, which has applied more than 1,250,000 cu. yd. of concrete to all manner of purposes in the last 25 years. It was not only a pioneer in the building of reinforced concrete box culverts and an early user of the concrete trestle, but has gained considerable distinction through the construction of large multiple-span concrete arch bridges. It has also taken leadership in special applications, as for example in mile posts, rail rests, concrete highway crossing pavements and fence posts of which about one-half million have been installed since 1911.



Improved Methods Were Employed in Making 27,900 cu. yd. of Concrete Placed in this Bridge

It is not surprising, therefore, that this road, at the initiative of J. B. Hunley, bridge engineer, has been one of the first to adopt advanced practices in the scientific proportioning of concrete materials, these methods having been applied in the making of some 50,000 cu. yd. of concrete during the last two years, including 27,900 cu. yd. in a large concrete bridge at Sidney, Ohio. However, it is not the thought that these methods must be limited to large structures. Indeed, it is the opinion of Mr. Hunley that they can be applied to work of any character that is under the control of a man thoroughly conversant with the details of the methods. The Big Four is now applying them on all concrete construction.

Desired Greater Uniformity in Results

The motive behind the adoption of these improved methods was the desire to obtain better concrete, that is, a greater uniformity in quality and the maximum strength to be had with a given quality of aggregates (sand and stone), and a given proportion of cement. For years, the Big Four followed commonly accepted practices in the mixing and placing of concrete. The concrete was mixed to a "sloppy" consistency according to fixed nominal mixes such as 1:2:4, 1:3:6, etc. Prevailing specifications for materials and workmanship were rigidly observed, but in spite of this the results were not always satisfactory. In some cases, the quality of the concrete was very good, in others it was inferior.

Efforts to correct this condition were frequently made by the men in charge of individual jobs through the use of a larger proportion of mortar or by adding more cement, and although this practice was favored as affording some measure of a correction for variations in the grading of the particles in the aggregates it was recognized that it was but a hit-or-miss method of approaching the problem. With the growing general realization that an excess of water in the mix was an important contributing factor in the development of unsatisfactory results efforts were made to mix the concrete dryer, but it was soon found that the amount of water caused such a loss in the workability of the concrete that it would not flow in chutes and could not be placed readily around the reinforcement.

But aside from the matter of unsatisfactory results as evidenced by the appearance of the finished structure, there was no little concern as to the strength of the concrete, particularly in reinforced concrete work in which the considerations of design presumed a specific compressive strength of the concrete as built. It was realized that any fixed mix such as 1:2:4 did not produce the same strength under all conditions for, as is well known, the strength is influenced by variations in the other controlling conditions. For example, it has long been established that the strength is affected by the gradation in the sizes of the particles and it has been developed more recently that the amount of water used has a very important bearing on the strength to be obtained. In view of this there seemed to be a definite need for some method of proportioning and mixing concrete that would not only insure greater security against defective work but which would also give reasonable assurance that the concrete made with any particular materials would develop a strength reasonably close to that assumed in the design.

The Basis

The foundation for such a method was at hand in the tables of the strengths of concrete developed by Professor Duff A. Abrams of the Materials Research Laboratory, Lewis Institute, Chicago, from an elaborate series of tests carried on over a considerable period of years with a wide variety of materials and made under different conditions as to mix, consistency, etc. These, in effect, gave the strength to be had on the basis of certain relations between the grading of the particles of sand and stone, the proportions of these aggregates to the cement and the amount of water used in mixing. The grading is expressed in terms of what is known as the "fineness modulus," the proportions in terms of the total amount of dry sand and stone (measured together and rodded) to a given amount of cement, and the quantity of water in terms of the consistency of the mixed concrete as determined by what is known as the "slump test." These terms will be explained later.

The relations given in Professor Abram's tables could not be applied directly. Based as they are on laboratory tests they must be converted into a form that makes them applicable to actual field conditions. For example, the proportions are based on the quantity of fine and coarse aggregate measured after they have been thoroughly dried, mixed and compacted by ram-

ming them with a rod, whereas under actual field conditions, the material is in loose piles and, except where pre-mixed aggregate (gravel) is used, the sand and stone are ordinarily in separate piles or bins and must be measured separately. Moreover, being exposed to the weather, they are not dry, but contain considerable quantities of moisture which, in the case of sand, has a bulking effect that leads to serious inaccuracies in the proportions unless properly accounted for.

This conversion from laboratory to field conditions was not readily obtained. It required an enormous amount of study and observation, but in the course of a year's experience with the method, in the mixing and placing of a large yardage of concrete, the various difficulties were ironed out and the practicability of the method was definitely demonstrated. Compression tests of large numbers of specimens made from concrete taken directly from the mixer from day to day demonstrated that the desired strength was being obtained. The appearance of the finished structures also evidenced the high quality of the concrete.

Field Instructions Developed

These studies and practical tests served as the basis for a set of detailed instructions accompanied by suitable tables and diagrams and complete examples of the method of determining the proportions, consistency, quantities, etc., for a given set of conditions. These have been issued to the men in charge of concrete construction on the Big Four and serve as the guide for the making of concrete by this method.

These instructions present a somewhat formidable appearance. There is a reason for this. The determination of the strength of concrete made with a given character of aggregates in certain proportions depends on a number of variable factors, all of which must be taken into consideration. However, the method as developed enables the field man to take account of each factor in turn by carrying out a definite procedure from one step to the next, each of which has been carefully explained in the instructions. It involves no intricate mathematics—nothing but a few simple calculations in ordinary arithmetic and once the method is thoroughly understood, these operations may be carried out in a few minutes' time whenever it is found necessary.

The fundamental principles are not new but the method has not been presented previously in so practical a form* and in order that our readers may consider it for the purpose of passing independent judgment on its merits we are reproducing below that portion of the instructions dealing specifically with it.

Instructions for Designing Concrete Mixtures

Concrete is made of cement, sand, stone and water, and any material change in the quantity or character of any ingredient will affect the strength and quality of the finished concrete.

Knowing the quantity and character of the various ingredients, if properly mixed and placed, the strength or quality of the concrete can be determined; or conversely, if a certain strength of concrete is desired, this strength can be closely obtained by combining the proper ingredients in the right proportions.

* The instructions were presented as an appendix to a paper presented by Mr. Hunley before the American Concrete Institute on February 25, 1924, which has been published in the form of a reprint by the Portland Cement Association.

It having been established that concrete of a predetermined strength can be made with careful selection and proportioning of materials and proper mixing and placing, it is evident that concrete so made is economical, as we have neither excess nor insufficient strength for the requirements of the structure, and usually the concrete will be better and more uniform in quality than that mixed under the usual arbitrary proportions.

Aggregates of the proper size and grading, and the combining of the sand and stone in the right proportions materially increase the strength of concrete, and assuming a given consistency and mix, the strength depends on the size and grading of the aggregate. Generally the larger and coarser the aggregate, the stronger the concrete. Coarse sand and the larger size pebbles produce greater strengths than the finer sands and smaller stones.

Fineness Modulus Easily Found

The term "Fineness Modulus" (hereinafter written F. M.) has been developed to indicate the size and grading of aggregates and their value for use in concrete. It is applicable to either fine or coarse aggregates or any combination of them.

The F. M. of an aggregate is determined by a sieve analysis, made with a set of U. S. Standard Square Mesh Sieves, each sieve having clear openings double the width of the next smaller size. The sizes are 100, 50, 30, 16, 8 and 4 meshes to an inch, and ⅜ in., ¾ in. and 1½ in. The percentage of aggregate (preferably by weight), coarser than each sieve is determined. The sum of these percentages divided by 100, is called the Fineness Modulus. After the F. M. of the fine and coarse aggregates have been determined, the F. M. of a mixture of the aggregates in any proportion can be found, or it is readily possible to find the proportion of fine and coarse aggregates to produce a certain F. M. in the mix. A sample sieve analysis of various aggregates is shown below:

	Per Cent Coarser than each Sieve									Fineness Modulus
Sieve	100	50	30	16	8	4	⅜	¾	1½	
Sand 0 to ¼ in.	100	95	81	42	6	1	0	0	0	3.25
Pebbles ⅜ to 1½	100	100	100	100	100	98	96	81	6	7.81
Limestone ⅜ to 1 in.	100	100	100	100	100	98	88	28	0	7.14
Sand and pebbles 0 to 1½ in.	100	98	95	87	77	61	44	30	7	5.99

There may be a wide variation in the results of the sieve analysis of different aggregates, but as long as the F. M. remains the same, uniform results may be expected in concrete, and by combining the sand and stone in the proper proportions the F. M. of the mixture can be made that which is best suited to the purpose.

How to Use the Fineness Modulus

As the maximum size of the aggregate increases, the F. M. increases and, until it becomes too coarse for the amount of cement used, the strength of the concrete increases. Larger F. M. can be used with rich mixes than with lean ones, and with round pebbles than with crushed limestone. Therefore, the best value of the F. M. will depend on both the mix and the maximum size and character of the aggregate. Larger values can be used in mass work than in light reinforced work.

When the F. M. of the sand and stone is known, the F. M. of a mixture of the two, in any proportion, can be obtained by the formula

$$M = \frac{r M_f + (100-r)\, M_c}{100} \qquad (1)$$

Where M = F. M. of the mixture.
M_c = F. M. of the coarse aggregate.
M_f = F. M. of the fine aggregate.
r = Percentage of fine aggregate used in the mixture.

Or, if a certain F. M. of the mixture is required, the percentage of fine aggregate to be used can be determined by the formula

$$r = \frac{M_c - M}{M_c - M_f} \qquad (2)$$

The desirable values of the F. M. of the sand (for mortars) and for the mixed aggregates (for concrete) for various mixes and maximum sizes of aggregates are shown in the following Tables I and I-a. (These were developed from a large number of laboratory tests.)

Table I.—Desirable Values of Fineness Modulus for Light Reinforced Work

True Mix, Volume of Cement to Mixed Aggregate	Sand For Mortar		Sand and Pebbles For Concrete			Sand and Crushed Stone For Concrete		
	0-4	0-¾ in.	0-¾ in.	0-1 in.	0-1½ in.	0-¾ in.	0-1 in.	0-1½ in.
1 to 1	4.75	5.60	6.50	6.90	7.35	6.25	6.65	7.10
1 to 2	4.20	5.05	5.90	6.30	6.70	5.65	6.05	6.45
1 to 3	3.90	4.70	5.50	5.90	6.30	5.25	5.65	6.05
1 to 4	3.60	4.40	5.20	5.60	6.00	4.95	5.35	5.75
1 to 5	3.45	4.20	5.00	5.40	5.80	4.75	5.15	5.55
1 to 6	3.30	4.05	5.85	5.25	5.65	4.60	5.00	5.40
1 to 7	3.20	3.95	4.75	5.15	5.55	4.50	4.90	5.30

Table I-a.—Desirable Values of Fineness Modulus for Mass Work

True Mix, Volume of Cement to Mixed Aggregate	For Concrete Sand and Pebbles		Sand and Crushed Stone	
	0-1 in.	0-1½ in.	0-1 in.	0-1½-in.
1 to 1	7.00	7.55	6.75	7.30
1 to 2	6.40	6.90	6.15	6.65
1 to 3	6.00	6.50	5.75	6.25
1 to 4	5.70	6.20	5.45	5.95
1 to 5	5.50	6.00	5.25	5.75
1 to 6	5.35	5.85	5.10	5.60
1 to 7	5.25	5.75	5.00	5.50

Fine aggregates used in concrete work should not have a higher F. M. than that shown for Sand O-4, for mortars, of the same mix. While the above values will give maximum strengths they may occasionally have to be reduced, to get a concrete which will work properly, particularly if the coarse aggregate contains a large percentage of coarse particles.

How to Apply Laboratory Results to Practical Work

The strength of concrete, assuming the size and grading of the aggregate and consistency to remain constant, depends upon the mix. This mix, as used in the charts and tables, refers to *true mix*, and represents the volume of mixed, dry and rodded aggregate used with one volume of cement.

The use of *true mix* is convenient for laboratory work, but such a condition of aggregates is not encountered in the field. As ordinarily used, the aggregates, especially the sand, contain more or less water, depending upon weather conditions, and are always loose or bulked.

To eliminate these variables the mixes for certain strength of finished concrete must be expressed in terms of true mix, but in the manufacture of concrete we must measure the sand and stone separately, not rodded or tamped and containing moisture, so that, in order to have concrete of the required *true mix*, we must know what volumes of loose, damp, sand and stone, measured separately, which may be called the *nominal volume*, will be required to make a certain volume of mixed aggregates dry, rodded, which may be called the *true volume*. The ratio of the true volume to the nominal volume depends upon the F. M. of the aggregates, the moisture content of the sand, the voids in the coarse aggregate, and the proportions of fine and coarse aggregates used, and is shown in Diagram II. It will be seen that for the usual mixtures this factor varies from about 65 per cent to 75 per cent. That is, 100 cu. ft. (the sum of the separate volumes) of sand and stone, measured when loose and damp, would, if dried, mixed, and rodded, produce 65 to 75 cu. ft. of dried rodded aggregate, depending upon the size of the material, moisture content of the sand, and proportions of sand and stone used.

This factor permits us to determine what nominal volume will produce a certain true volume, or what

The Fineness Modulus is Easily and Quickly Determined

nominal mix would be required to give a certain true mix, the nominal mix being the sum of the volumes of the separate aggregates, measured loosely in their normal condition, used to one volume of cement. For example, in a mixture of 1 part cement, 2.5 parts sand and 4.5 parts stone, the nominal mix would be 1 to (2.5 + 4.5) = 1 to 7. If the proper factor from Diagram II were 70 per cent, the true mix would be 1 to (7.x.70) or 1 to 4.9.

Volume Shrinks When Separate Aggregates Are Mixed

Usually separate aggregates will be furnished, consisting of washed sand, 0 to ¼ in. in size, and pebbles and crushed boulders or crushed limestone, ⅜ to ¾ in., ⅜ to 1 in., ⅜ to 1½ in. in size, depending upon the character of the work. The proportions of sand and stone used will depend upon the desired F. M. of the mixture. Ordinarily the amount of sand used will be between 20 per cent and 60 per cent, by volume, of the mixture.

When sand is mixed with stone, the volume of mixed aggregate is less than the sum of the volumes of the separate aggregates, and under ordinary conditions this ratio is between 80 per cent and 90 per cent, depending upon the moisture content, size of aggregate and proportion of sand and stone.

In the preceding example the 2.5 cu. ft. of loose sand added to 4.5 cu. ft. of loose stone, would produce say —6.0 cu. ft. of loose mixed aggregate. If one sack of

cement were used with the sand and stone as before, the *apparent mix*, as it may be called, would be 1 to 6.0. The term "apparent mix," however, would not be used except when a premixed aggregate (concrete gravel) is used. If the 6.0 cu. ft. of mixed aggregate were dried and rodded or tamped it would shrink (using the same true mix factor as before) to 4.9 cu. ft.

For certain unimportant work a premixed aggregate (concrete gravel) may be furnished. This is either run of pit gravel as it comes from the bank, or gravel washed and graded to some extent to produce the proper proportions of sand and pebbles. Its use should be discouraged, as its F. M. will be found to vary continuously over wide ranges and consequently it is difficult to maintain a uniform and correct mixture. Where it is used the same F. M. as used for separate aggregates, sand and pebbles, should be maintained, by adding sand or pebbles as may be necessary. The volume of premixed aggregates used to one volume of cement is the apparent mix. The ratio between the true mix and apparent mix can be assumed as 85 per cent.

Aggregates Must Be of Good Quality

Aggregates should be sound structurally, free from organic impurities, and clean, without coatings and dust. Inasmuch as sand and pebbles are usually furnished washed, and from tested pits, they are likely to be satisfactory. They should be examined, however, and any dirty materials rejected. Crushed limestone, especially should be watched, as this often comes full of dust and screenings. Organic impurities in the sand can be identified by the Colorimetric Test.*

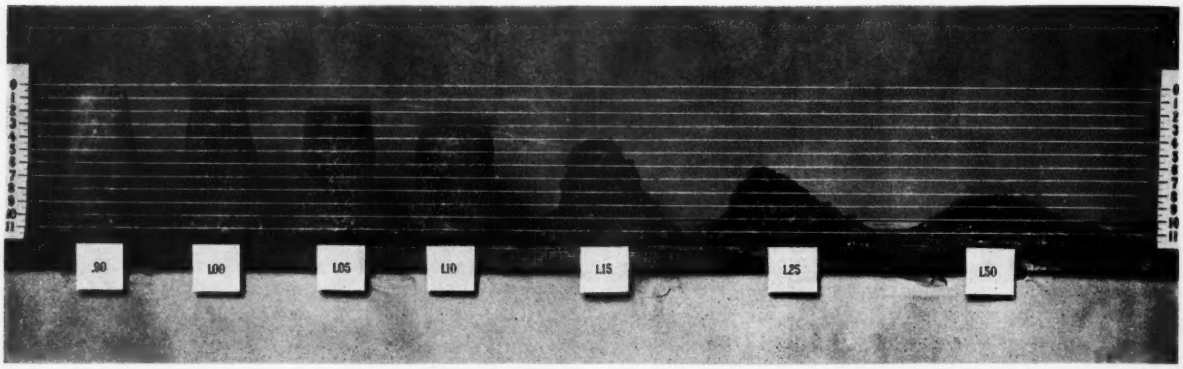
Frequent sieve analyses should be made of the fine and coarse aggregates, and should any marked variation occur in either or both of them, the proportions of sand and stone should be varied (Formula 2) so as to give the required F. M. of the mixture of the two.

In proportioning the batches care should be exercised to see that the amounts of sand and stone are measured with accuracy, so as to get a uniform mix. Due to the change in the moisture content of the sand, the nominal mix may have to be changed to maintain the same true mix. When the mixer is charged from hoppers, or cars, lines or points can be marked for certain volumes, and the aggregates leveled off to these lines. If wheelbarrows are used, they can be marked for certain volumes, and the materials in them leveled off by means of a templet. With hopper scales the aggregates can be accurately proportioned by weight, after the weights per unit volume of the aggregates are known.

* This is a method whereby the amount of humus in the sand may be judged from the color obtained by shaking the sand in a solution of sodium hydroxide.

Amount of Mixing Water Is Important

The amount of water used in mixing concrete affects its strength as much as the quantity of cement used. It has two functions; to hydrate the cement, and to lubricate or make the aggregate workable. The strength of the concrete depends upon the *water cement ratio* or ratio of volume of mixing water to the volume of cement. The smaller this ratio, the stronger the concrete, as long as there is enough water to make it workable. Decreasing the amount of water increases its strength. A dry mix, but still workable, will, with the same proportions of cement and aggregate, be about twice as strong as if water were added to produce a sloppy mix. This means that to secure a certain strength, if a dry mix instead of a very wet one is used, only about one-half the cement would be required. As an example, to produce a concrete having a strength of 2500 lb., if it were mixed wet, would require a true mix of about 1 : 2.2; if it were mixed dry, but still be workable, the required true mix would be only 1 : 4.6.



Examples of Seven Slump Tests with Tags to Indicate Relative Consistencies

Rich mixtures require less mixing water per sack of cement than lean ones, as there is a smaller volume of aggregate per sack of cement; coarse aggregates require less mixing water for the same consistency than fine aggregates. Then the quantity of mixing water may be changed, due to:

(1) Change in mix (cement content).
(2) Change in size and grading of aggregate.
(3) Change in consistency.

The required amount of mixing water, includes the water which is contained in the aggregate as well as that added at the mixer. The total amount of mixing water required for various mixes, aggregates, and consistencies is known, but this particular amount includes that in the aggregate which is generally unknown and a variable, so that the amount to be added to the batch to give certain consistencies is a variable.

The Slump Test

A simple method of determining and regulating the consistency of concrete is by the slump test. The apparatus consists of a truncated cone, made of sheet metal, with a handle or grip on either side. The frustrum of the cone has a diameter of 4 in. at the top, 8 in. at the bottom, and is 12 in. high. The form is placed on a level surface and is filled with the concrete

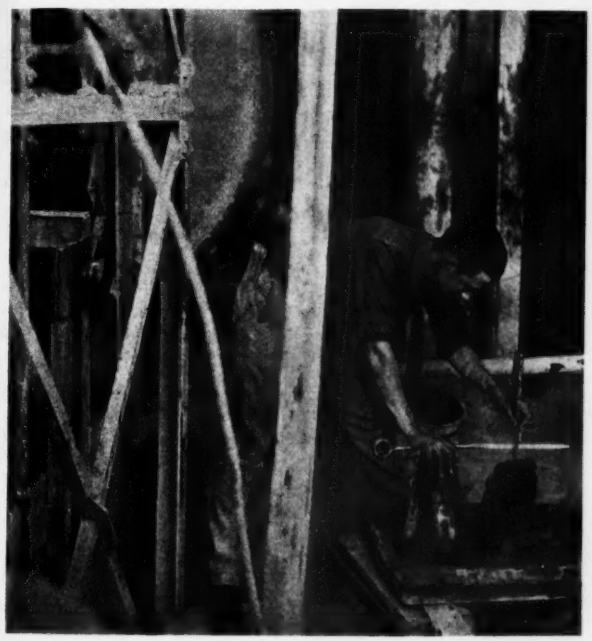
to be tested, in layers about 4 in. deep, each layer being rodded 30 times with a pointed rod; the top being leveled off. Immediately after the form is filled, it is gradually lifted, vertically, and the amount the concrete settles or slumps, represents the slump.

Concrete having a slump of ½ to 1 in. will contain but little more water than that necessary to produce the maximum strength, but would be a little too dry to use in construction work. Concrete having such a slump is said to have a *relative consistency*, for ordinary mixes, of 1.00. Concrete containing 10 per cent more water has a relative consistency of 1.10 and would have a slump of 3 to 4 in. Concrete containing 25 per cent more water (relative consistency 1.25) would have a slump of 6 to 7 in., and 50 per cent more water (relative consistency 1.50) would have a slump of 8 to 10 in.

To emphasize again the importance of using as little water as possible, the expected strengths for various slumps, or relative consistency, with the same aggregate and mix (F. M. equals 5.8 and true mix equals 1 to 4) is shown below:

Slump	Relative Consistency	Strength
½-1 in.	1.00	3250
3-4 "	1.10	2850
6-7 "	1.25	2200
8-10 "	1.50	1500

It will ordinarily be possible to work a concrete having a slump of 3 to 4 in., but if but little more water is added so that a slump of 8 to 10 in. is obtained, and



The Slump Test is Made at the Mixer

much concrete is poured this wet, the strength will be only half that of the drier concrete using the same amount of cement and aggregate. If more water is used it is necessary to increase the amount of cement to secure the same strength, and this, of course, is wasteful. *There should always be used the smallest amount of mixing water possible to give a mixture sufficiently plastic for the work at hand.*

For the same mix and the same relative consistency, coarse aggregates require less water than fine ones, and the amount of water required for the same relative consistency decreases somewhat as the time of mixing increases. Consistencies of concrete, as represented by the slump, which should be used for various classes of work are as follows:

Table II

Type of Construction	Maximum Slump, in.
Mass Concrete	3 to 4
Reinforced concrete:	
Heavy sections, reinforcement more than 4-in. centers	3 to 4
Heavy sections, reinforcement less than 4-in. centers	4 to 5
Light sections, but easily tamped, reinforcement more than 4-in. centers	3 to 4
Light sections, or thin vertical walls, which are difficult to tamp	5 to 6
Floors, in buildings, platforms and pavements	1½ to 2½

The above slumps represent the maximum which should be permitted, and if a drier concrete can be worked satisfactorily, as determined by trial, lower

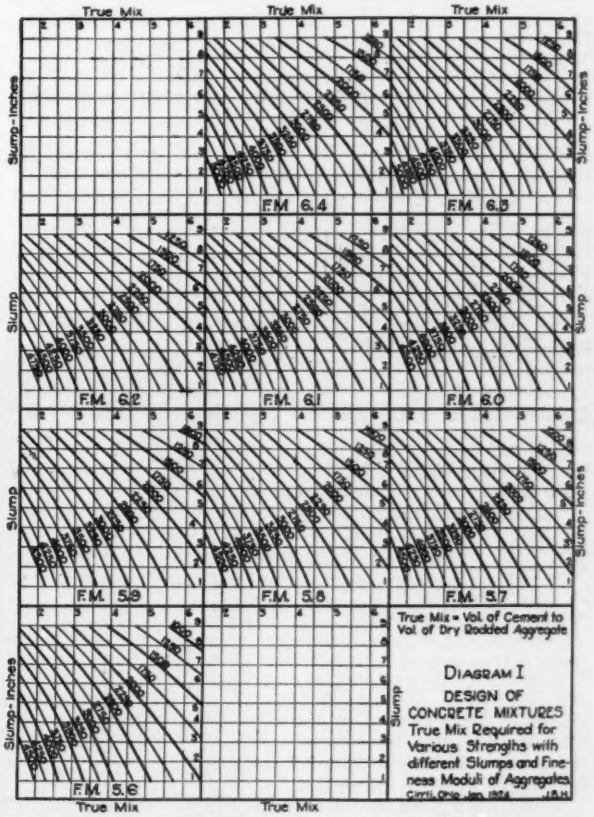


Diagram I. Compressive Strength Obtained in Laboratory Tests for Various Values of the Slump and Fineness Modulus.

slumps should be used. The mixing water used should be clean, containing but little, if any, sediment, and free from organic matter, acids and alkaline salts.

Quantities of Materials Required for Making Concrete

The size of the batch is usually determined by the capacity of the mixer, the total volume of aggregates remaining constant, so that after the nominal mix is found from the required true mix, the amount of cement required per batch is frequently found to be so many bags and a fraction. It is difficult to measure the cement nearer than to the half bag, and if, for instance, it were found that 4¼ bags were required to the batch, 4½ bags would be used, or 4½ bags might be used in one batch and 4 bags the next, thus obtaining an average of 4¼ bags.

The volume of concrete obtained from a unit volume of aggregate is affected somewhat by the size and fine-

ness modulus of the aggregate used, and the relative consistency of the mixture, and largely by the mix.

Table III

True Mix	Volume of Dry Rodded Aggregate	VOLUME OF CONCRETE PRODUCED Aggregate 0 to ¾ in. Relative Consistency and Slump			Aggregate 0 to 1½ in. Relative Consistency and Slump		
		1.00 ½-1 in.	1.10 3-4 in.	1.25 6-7 in.	1.00 ½-1 in.	1.10 3-4 in.	1.25 6-7 in.
1 to 7	100	101.5	102.0	103.0	99.0	99.5	100.5
1 to 6	100	102.5	103.5	104.5	100.0	101.0	102.0
1 to 5.5	100	103.5	104.5	106.0	101.0	102.0	103.5
1 to 5.0	100	105.0	106.0	107.5	102.5	103.5	105.0
1 to 4.5	100	107.0	108.0	110.0	104.0	105.0	107.0
1 to 4.0	100	109.0	110.0	112.0	106.5	107.5	109.5
1 to 3.5	100	112.0	113.0	114.5	109.5	110.5	112.0
1 to 3.0	100	116.0	117.0	119.0	113.0	114.5	116.5
1 to 2.5	100	120.5	122.0	123.5	118.0	119.5	121.0

This ratio is known as the yield and can be conveniently expressed in terms of the volume of dry rodded aggregate (true volume), and the true mix. From Diagram II the ratio (R) between the volumes of dry rodded aggregate and separate loose aggregates can be found, and by applying the yield factor corresponding to the true mix used, the total volume of sand and stone to produce a certain volume of concrete can be determined. The proportion of sand and stone needed is known after the per cent of sand "r" is found. The yields are shown in the following Table III. They are based on a F. M. of about 5.8. For a F. M. of 5.6 they should be increased about 1 per cent; for a F. M. of 6.0 they should be decreased 1 per cent; and for a F. M. of 6.2 decreased about 2 per cent. No allowance for waste is included.

Specimen Design of Concrete Mixture

Suppose that we are given a concrete structure to build, the plans for which call for concrete to have a strength of 2,000 lb. per sq. in. The aggregates furnished are sand, 0 to ¼ in., and crushed boulders, ⅜ to 1½ in. We will assume, for trial purposes, a F. M. of 5.8. The work is of such character that from Table II we find the slump to be used is 3 to 4 in. To be on the safe side we will use a 4-in. slump to design the mix.

Referring to Diagram I, we find that to obtain 2,000-lb. concrete, using a F. M. of 5.8 and a slump of 4 in. will require a true mix of 1 to 5.7. For this approximate mix we find, from Table I-a, that the correct F. M. would be 5.9. Referring again to Diagram I, and using a F. M. of 5.9, we find that the true mix for the 2,000-lb. concrete is 1 to 5.8. That is, if we use one sack of cement with 5.8 cu. ft. of the dried and rodded aggregate, we can expect a concrete having a strength of 2,000 lbs. per sq. in.

Suppose the sieve analysis shows that the sand has a F. M. of 3.25 (Mf) and the stone a F. M. of 7.75 (Mc). Then from Formula 2:

$$M=5.9 \quad r=\frac{7.75-5.9}{7.75-3.25}=41.1 \text{ per cent sand.}$$

If the sand used were dry, we find from Diagram II (for crushed boulders) ("r" being 42 per cent for the 2000-lb. concrete) the ratio of true volume to nominal volume is 0.75. Then to produce 5.8 cu. ft. of dry rodded aggregate would require 5.8÷0.75, or 7.60 cu. ft. of sand and stone, giving a nominal mix of 1:7.6. Of this, 42 per cent or 3.19 cu. ft. will be sand and 4.41 cu. ft. will be stone, and the proportions are 1:3.19:4.41. If the sand contained, say, 5 per cent moisture it would require (see table on diagram II) 1.19 cu. ft. of such loose wet sand to make 1 cu. ft. of loose dry sand, and we would therefore have to use in the batch 3.19x1.19 or 3.80 cu. ft. of this wet sand, with 4.41 cu. ft. of stone, and the proportions become 1:3.80:4.41. The nominal mix is 1:8.21 and the percentage of sand used is 3.80÷8.21= 46.3 per cent.

The nominal mix for sand containing any amount of moisture can be also read directly from Diagram II. Starting at 42 per cent on the curve for dry sand, and following the diagonal line up to the left to the point of intersection with the 5 per cent moisture curve, we find the factor "R" to be 70 per cent and percentage of sand 46.5 per cent. Then the nominal volume is 5.8÷0.70=8.28, of which sand is 46.5 per cent or 3.85 cu. ft., while the stone is 4.43 cu. ft. or practically what we get by computation.

Moisture in the Sand

The variation in the nominal volume and proportions due to change in the moisture content of the sand is clearly shown by the above example. In dry weather the sand will rarely contain less than two per cent moisture and even after heavy rains more than eight per cent, but the amount of moisture in it should be determined daily. This can be done by taking a small volume not less than 0.1 cu. ft. and weighing it while wet. Then dry it and weigh and the difference in weight will be the weight of water. The weight of water divided by the weight of dry sand will give the per cent of moisture originally contained.

Facilities are not always available for drying the sand and a close approximation as to the moisture content can be had by determining the weight per cubic foot of the wet sand. This weight can be found by filling a pail of known volume with the loose damp sand and weighing it. From Diagram II the percentage of moisture can be found when the weight per cubic foot is known. This method is so simple that the inspector can make the test several times daily if necessary.

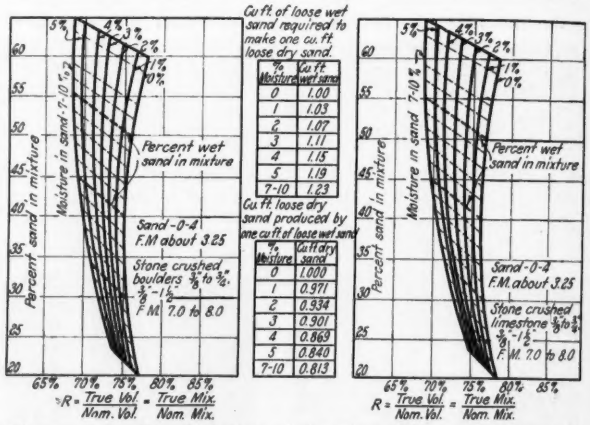


Diagram II. The Relation of the True Mix to the Nominal Mix.

It is not always practicable to change the amount of sand used in the batch with each change in the moisture content, but it should be done whenever possible or when the change is a material one. In establishing the batch it would be well to assume two per cent moisture in the sand and when it is wetter increase the volume of sand used if practicable. If the volume is not increased no particular harm is done except that the mixture will be a little coarser or harsher, but this is not objectionable as long as it works well. If the F. M. of the fine or coarse aggregates or both should change the new value of "r" should be computed and the proportions varied accordingly.

Quantities of Materials Required

Assuming that the mixer has a capacity of 30 cu. ft., we could use in each batch (5 per cent moisture in sand), for the 2000 lb. concrete, 3.5 sacks of cement, 13.3 cu. ft. of sand, and 15.4 cu. ft. of stone.

We will now determine the materials required for the structure, assuming that there are 1,200 cu. yd. concrete. The true mix is 1:5.8, the F. M. is 5.9, the slump is 3 to 4 in., and the gradation of aggregates from 0 to 1½ in. From Table III, interpolating and correcting for the F. M. of 5.9, we find the yield to be 101 per cent. So to produce 100 cu. yd. of finished concrete would require 100÷101=99 cu. yd. of dry rodded aggregate. From Diagram II using dry sand we find to produce 99 cu. yd. of dry rodded aggregate would require 99÷0.75 or 132.0 cu. yd. of sand and stone, measured separately, when in a loose or bulked condition.

With a true mix of 1 to 5.8 the amount of cement per 100 cu. yd. of finished concrete is (99÷5.8) 27=461 cu. ft. or 115.25 bbl. Then for the 1200 cu. yd. of concrete there would be required:

Cement—12x115.25=1383 bbl.
Dry sand and stone—12x132.0=1584 cu. yd.
Dry sand—42 per cent or 1584x0.42=665 cu. yd.
Sand as received (4 per cent moisture) 665x1.15=765 cu. yd.
Stone 58 per cent=919 cu. yd.

Roadmasters Have Large Attendance at New York Convention

Over 400 Members Participate in a Full and Well Balanced Program on Practical Subjects

THE FORTY-second annual convention of the Roadmasters and Maintenance of Way Association, which was held at the Hotel Commodore, New York, on September 16-18 was exceedingly successful, both from the number in attendance and the character of the program. Over 400 roadmasters, supervisors, engineers and others responsible for the maintenance of tracks were in attendance at the business meetings of the association and at the exhibits of the Track Supply Association. The program was well diversified as to its maintenance character and many of the subjects were treated from both an operating and a maintenance viewpoint. Augmenting the various reports of the committees, were a number of papers on special subjects. These covered the Economics of Track Maintenance by G. L. Moore, engineer maintenance of way of the Lehigh Valley, Bethlehem, Pa.; the Marking of Steel Rails by C. W. Gennet, Jr., manager rail inspection department, Robert W. Hunt Company, Chicago; Rail Laying Methods on the Canadian Pacific by E. Keough, assistant engineer maintenance of way, Eastern Lines, Canadian Pacific, Montreal, Que., and the Roadmaster's Responsibility for the Protection of Grade Crossings by F. W. Hillman, division engineer, Chicago & North Western, Chicago. This program of reports and papers was also supplemented by addresses on the broader phases of railway operation and maintenance by W. G. Besler, president of the Central of New Jersey; R. H. Aishton, president of the American Railway Association, and W. J. Backes, assistant general manager of the New York, New Haven & Hartford. These reports, papers and addresses are given in full or in abstract on the following pages.

The convention was presided over by J. B. Martin, general supervisor of track, New York Central Lines West, Cleveland, Ohio, and president of the association. The other officers of the association for the past year were: First Vice-President, W. F. Muff, roadmaster, Atchison, Topeka & Santa Fe, Newton, Kan.; Second Vice-President, G. W. Morrow, supervisor, New York, New Haven & Hartford, New Haven, Conn.; Secretary, P. J. McAndrews, roadmaster, Chicago, & North-Western, Sterling, Ill., and Treasurer, T. F. Donohoe, general supervisor of road, Baltimore & Ohio, Pittsburgh, Pa. The members of the Executive committee are: R. L. Haring, supervisor, Long Island, Jamaica, N. Y.; M. Henry, supervisor, Chicago & Eastern Illinois, Villa Grove, Ill.; J. P. Davis, engineer maintenance of way, Central Indiana, Anderson, Ind.; C. H. Gruver, roadmaster, Chicago, Rock Island & Pacific, Manly, Iowa; George W. Koontz, division engineer, St. Louis-San Francisco, Ft. Worth, Tex.; C. A. Joyce, supervisor, Erie, Paterson, N. J.; H. R. Clark, district engineer, Chicago, Burlington & Quincy, Lincoln, Neb.; B. C. Dougherty, roadmaster, Chicago, Milwaukee & St. Paul, Chicago; J. P. Corcoran, roadmaster, Chicago & Alton, Bloomington, Ill., and E. T. Howson (honorary), editor, *Railway Engineering and Maintenance*, Chicago.

J. B. Martin
President

Since his election to office a year ago, Mr. Martin has received well-earned recognition from his road, the New York Central Western Lines, in the form of a promotion from supervisor of track on the main lines at Elkhart, Ind., to general supervisor of track maintenance, with headquarters at Cleveland, Ohio. His election to the presidency of the association came at the end of seven years of earnest effort and wholehearted interest in its affairs coincident with his gradual advancement in an official capacity, beginning in 1920 when he presented a report on highway crossing construction as chairman of a committee assigned to that subject the year before.

Mr. Martin, in calling the convention to order on Tuesday morning, emphasized briefly the factors of careful planning and organization in securing efficiency in the conduct of the maintenance of way department and thus in the railroad operation as a whole. He stated that as transportation is commonly accepted as one of the bases upon which our industrial fabric is built, it is of great importance that it be both efficient and economical. Maintenance of way men are important factors in this scheme. The operation of the railroads can be neither efficient nor economical without properly maintained tracks and structures and, as the work of the roadmaster involves a large expense and interferes to some extent with traffic, it is essential that it should be well planned and managed.

There is a constantly increasing demand on the railroad plant to bring about more production with the same facilities. This takes the form of increased loads and a greater number of trains and there is every reason to believe that this increased de-

A 50-Mile Ride in New York Harbor Was Taken on Tuesday

mand will continue. For this reason the proper solution of railway maintenance problems assumes a growing importance. Roadmasters, from their knowledge and daily contact, are peculiarly qualified to carry on this work and should have the earnest and active support of all who are interested in maintenance work.

Responsibilities and Duties of the Roadmaster

BY W. G. BESLER
President, Central of New Jersey, New York

IN 44 YEARS of active railroad life I have passed through and had personal experience with almost all of the positions from that of an employee and then of a subordinate officer, to that of the chief executive of a railroad. Naturally I have come to know the relative worth and value of each of the component parts and departments of the complex organization required for the successful functioning of railroad operation. Your organization is composed of practical railroad men for whom I have always cherished the greatest love and respect, because you are occupying the difficult and very often unpleasant service of performing the hard and dirty work which the job implies.

Who goes out, more often by night, in a bleak, wintry wind with its drifting snow, and cleans the switches and keeps the road open? The Roadmaster.

Who hastens to the scene with accumulated section and bridge men, or an extra gang, to meet and deal with a fire and a burn-out? The Roadmaster.

Who is called out of bed and told by telephone or the call-boy that there is a washout with traffic at a standstill, and who goes by handcar or work train to the scene to repair the damage? The Roadmaster.

Who is among the first to be notified that there has been a bad accident and that all tracks are blocked and the track torn up, and to get to the scene with all possible speed? The Roadmaster.

Who goes to the office on Sunday mornings to see if everything is well? The Roadmaster.

Who is called upon and generally makes proportionately the largest contribution when the order goes out to reduce expenses? The Roadmaster.

Who among subordinate railroad officers has the highest percentage of injuries and deaths from motor car and other accidents? The Roadmaster.

Who makes possible a speed in safety of 75 miles per hour for an express train? The Roadmaster.

Some Phases of the Grade Crossing Problem

If I may digress for a moment, I desire to consider the matter of highway crossings at grade and the ever-increasing number of accidents, many of them of an appalling character, which have come to pass. You roadmasters build and maintain highway crossings at grade. You erect and keep in position the statutory warning signs as required by law, and generally, except perhaps in those cases where electric devices or other similar appliances are maintained by the signal department, you are responsible for the conditions at those crossings and in general you provide the crossing watchmen.

An entirely new situation has come to pass in a remarkably short period of time—a situation for which the railroads are in no wise responsible. We are running our trains upon the only place we have for them, viz., upon the rails. The new condition to which I refer has been created by the public which is so loudly demanding the elimination of grade crossings, or their protection day and night by gates and gatemen.

Newspapers, editorially and with glaring headlines and reading matter, are commenting upon the "death traps" maintained by the railroads. Who made them "death traps"? Why are they "death traps"? To what extent can the railroads be held responsible for the conduct of the driver of an automobile?

Responsibility ordinarily implies *control*, yet I know of no law which has been passed or proposed which gives the railroads any control over the conduct of an autoist. It takes two to make a quarrel, and, generally speaking, it takes two to make an accident; and again, generally speaking, the motorist comes within the category of the aggressor.

Now, what are we going to do about it?

The demand for crossing elimination and the demand for crossing gates and gatemen to meet a condition created *by* the public, for the safety and protection *for* the public, and *of* the public, calls for the expenditure of hundreds of millions of dollars, and, in my opinion, it should be shared by those for whose convenience, comfort and safety it is provided, namely, *the public*.

Some states have passed laws providing in the case of grade crossing elimination, for the state, county or city to bear a proportion of the expense. Other states place the entire expense squarely upon the railroads, which are running their trains no faster than under previous conditions, and, as I have said, cannot absolutely control the speed of the motorist who is the occasion of the collision.

The solution of the matter can be very much expedited if a healthy public sentiment can be created which will bring home to the people of this country that the railroads have reached the point where they can no longer carry an increasing burden of taxation such as has been fastened upon them.

The railroads of this country are paying in taxes upwards of one million dollars per day, and these taxes are

Members of the Association on the Central of New Jersey Pier at Sandy Hook, N. J.

in many cases being used to construct concrete highways alongside, and upon which auto trucks and other commercial vehicles are traveling without expense, except for an insignificant cost for a license, etc., in active competition with the railroads.

What the railroads need is not more laws, but an enforcement of the present laws, and an abatement of the flood of hundreds of bills which sweep into the national and state legislatures, and an assurance that the tax burden already enormous will not be increased, but that this burden may perhaps be lessened. It is to the interest of every one of us to see that this is done.

Report on Work Trains—When to Eliminate and How to Get the Greatest Efficiency

THE USE of work trains must have begun with the advent of railroads, as nearly as we have been able to determine, and has continued to the present day to be regarded as an indispensable facility. However, the constantly rising cost of this class of service has prompted investigation and study in recent years on the part of railroad officers, and on many lines, ways have been developed to eliminate the work train for certain classes of work and by improving its efficiency in various ways to curtail its use. The vast difference in conditions, operating and physical, on the railways throughout the country, prohibits this committee from offering specific recommendations. It is our opinion that the question is one to be analyzed closely by the officers of each road with a view of devising ways to meet the local conditions with the object of curtailing their use where possible and increasing their efficiency by methods best suited to their particular conditions. Therefore, this report is presented with the understanding that all conditions cannot be met by the same methods.

The subject ranges from the operation of assigned work trains on roads where the amount of work at hand requires their constant use in maintenance or on large construction jobs down to the train called to perform a single day's work as the occasion demands.

The Possibility of Elimination of Work Train Service

In dealing with the first part of this subject, it is well to bear in mind that elimination must not be secured by substitution that will be more costly or hazardous; neither should it be the cause of necessary work being left undone.

The utilization of local train service is one method of substitution which can be used profitably on single or double track lines where material can be unloaded outside of the tracks and where other operating conditions are favorable. Naturally their use is limited by the amount of material which is to be handled and by the amount of time available for this class of service on the part of such trains. The loss of time by trackmen waiting for local trains at locations where work is to be performed, must also be taken into consideration. Work should not be planned which will run into overtime at rate and one-half cost. This can usually be avoided by keeping posted on local train movements.

The loading and unloading, of carload, or part carload lots, of nearly all classes of material, such as ties, ballast of all kinds, small consignments of relay rail, small track fastenings and material for repairs to road crossings and platforms, can be handled by local freight. Carload lots of material for distribution on various sections can be handled readily by local trains by billing cars from one station to another, the foremen being furnished with lists of the materials consigned to their sections and, after unloading their materials, forward the car to next station on the list. Miscellaneous scrap rail, etc., which has been assembled at section headquarters on outlying sections, can be picked up in this manner and forwarded to destination. Efficiency can be promoted by encouraging train and enginemen in local service to put forth their best efforts in this class of work. Their officers should demand efficient service from them in this connection. It is our opinion that, where conditions are favorable, local freight service is practical and economical for the handling of materials in small lots, but that in most cases where large consignments are to be dealt with, it will not pay to delay cars under load for extended periods of time waiting for the local trains to handle, unless they are system cars where demurrage would not have to be taken into consideration and where the equipment is not needed elsewhere. This manner of handling large consignments will also cause disorganization of track gangs. Local trains should be used to the fullest extent in preference to work trains, where it is proved that a saving in dollars and cents can be effected by their use.

Lines fortunate enough to be equipped with good motor cars and trailers on their sections have at their disposal a means of transportation which can, without doubt, be used to advantage for the distribution of certain materials to the extent permitted by the capacity of the motor cars in use. The density of traffic and the distance between sidings where cars can be unloaded are naturally important factors in the economical transportation of material by this means. Some lines where ties are received during the winter and early spring months and no installations are made,

due to frozen roadbed, while the gangs are limited to three or four men, report a substantial saving by unloading ties and fence posts at stations and transporting a few each day to points where they will be needed as gang goes to work. In this manner at least a part of the renewal ties are distributed exactly where wanted by the time the frost goes out without the cost of work train service or interference with other working plans. Along this line, adjoining section gangs can be doubled up and, by working on tie distributions, can handle a large number of ties as well as some other classes of material. It is the opinion of your committee, however, that the quicker the material required is put on the ground where needed, the greater the efficiency procured, as track gangs should not be taken away from construction work any more than is absolutely necessary or have their day's work broken into. Therefore, we recommend that the season's allotment of ties always be delivered as early as possible, and when secured in large allotments, be distributed with work trains, using men enough to unload several cars at once as the train moves over each section.

Mr. Muff has been in responsible charge of track maintenance almost continuously for the past 20 years, having been appointed roadmaster on the Chicago & Alton at Louisiana, Mo., in 1904. For the past 16 years, barring a brief leave of absence, he has occupied a corresponding position on the Atchison, Topeka & Santa Fe at Newton, Kans. In point of his connection with the association Mr. Muff is one of the younger members, having been elected in 1918. However, he has been exceedingly active as a committee chairman, director and vice-president.

W. F. Muff
First Vice-President

We believe that motor cars and trucks should be substituted for work trains in transporting men to and from work in all cases where it is not necessary to handle anything but labor and no other work is required of the train. In this manner practically all delays caused by meeting and passing trains and on other accounts, can be eliminated and, as this service is cheaper than work trains, a nice saving is effected.

Self-propelled locomotive cranes with magnets are proving to be a money-saving substitute for the work train in large material yards and are very desirable in handling work of this nature.

How to Get the Greatest Efficiency from Work Trains

Careful consideration and planning with the view of getting material on the ground and work train work performed during the season of the year when traffic is the lightest, and being thus enabled to eliminate as much of this work as possible during periods of heavy traffic is a feature of great importance and worthy of much consideration by all concerned. We feel a large saving can be made thereby. Wherever possible, cars of a kind from which material can be handled most economically should be arranged for when purchases of new material are made. A considerable saving can often be made in the cost of handling by this means.

This committee is of the opinion that the ability of the person in charge of the operation of work trains is one of the most important factors in successful operation. In dealing with assigned trains it is possible to exact the highest degree of efficiency. These are usually preferred jobs for train and enginemen, as well as for the foremen and labor. It is a well-known fact that certain conductors and enginemen are particularly adapted to this class of service and it is always possible to choose the best for assigned trains. The same preference should be used in choosing foremen and labor. Crews called to perform an occasional day's work cannot well be hand-picked, but their performance should be checked and the trainmaster, as well as the roadmaster or supervisor, should accompany them when possible. All crews should be impressed with the fact that their day's work is of the utmost importance to the company and they should be called upon to explain unnecessary delays or lack of proper performance, as well as being commended favorably for unusually good service.

In this connection we recommend that all conductors and foremen be required to furnish daily reports to operating and maintenance officers in charge of their day's work, citing performance and delays, and these reports should be checked carefully by these officers, who should call on foremen and crews to explain unnecessary delays or failure to perform to reasonable standards of efficiency. As complete an outline as possible of the work to be done each day should be furnished by the maintenance officer in charge, to the conductor, enginemen and foremen, in advance. A thorough understanding by all concerned is necessary to the end that no confusion occur during the day with consequent chance of delay. All members of the work train organization should be made to feel their share of the responsibility.

Mr. Morrow is representative of the younger men of technical education who are choosing track maintenance for their career in increasing numbers. He is a supervisor on the main line of the New York, New Haven & Hartford between New Haven, Conn., and New London. He has taken a keen interest in the activities of maintenance of way associations serving as chairman of the committee which reported on labor saving devices at the 1922 convention of the Roadmasters' Association. He has also been identified prominently with the Metropolitan Track Supervisors' Club of New York.

G. W. Morrow
Second Vice-President

We do not consider it advisable to outline the number of men necessary to perform each kind of work in this service. The methods in use vary greatly and an organization must be perfected to cover each set of conditions. Sufficient men should be furnished to push

the work at maximum speed each available minute of working time without any unnecessary expenditure. In the case of permanently assigned crews it is desirable to vary the number of men, keeping an average size gang and assigning those not required with the train for certain kinds of work, to other jobs. For this reason it is advisable to have an assistant foreman who can be left in charge of men employed away from the train. In this manner trained men are available at all times for all classes of work. Efficiency is not alone a matter of speed and it must be borne in mind that material should be distributed exactly where needed and as nearly as possible in the right amounts. Careless handling in this respect will prove more costly in subsequent delays to track gangs than any saving that can be effected in speeding up the unloading. Crews should be impressed with the necessity of doing good work.

As secretary of the Roadmasters' Association for the past nine years, Mr. McAndrews is probably better known than any other roadmaster on American railways. It is no small tribute to his administration of the business affairs of the association that it has enjoyed its greatest growth during his tenure of office. He became a member in 1907 and was elected president in 1914. He has been responsible for track on one of the heaviest traffic sub-divisions of the Chicago & North Western for the past eight years.

P. J. McAndrews
Secretary

Adequate power is of the utmost importance and the old idea which has prevailed, "that any old engine is good enough for a work train," must be dispelled in some way. It is our belief that the maintenance department is entitled to be furnished with adequate power for its work trains and that where it is not being furnished, and is available, those in charge should keep the matter before their superior officers until the condition is overcome.

Where water stations are far enough away from the work to cause unnecessary delays to men who are required to remain idle while the engine is running to a distant station for water, this condition should be overcome. We believe that where such conditions exist water should be furnished for work train engines also. Engines with the largest tanks available should be furnished for this service. Roundhouse delays are also a source of great expense and we should insist on our work train engines being ready to leave on call.

Cooperation between the different departments involved is highly important. Without it many costly delays will occur. While the work train is an added burden to the despatcher and frequently a source of delay to other trains, its importance must be considered. Good dispatching will save a great deal of money when applied to work train service.

Power machines and up-to-date equipment of proven efficiency, properly operated, are great money savers when used in connection with work trains. Where air machines are in use, particular attention should be given to the air pumps on locomotives to see that they will provide sufficient air to operate rail loaders, etc., without delay. For loading and handling rail we recommend the double end rail loader with which some excellent records are being established, both in the amount of work done and low unit cost. Where the equipment is available it is economy to use two or more ditchers with one train, thus cutting down the work train days. Self-cleaning air dump cars on either side of the ditchers with modern spreader plows combine to reduce work train days.

Safety in Operation a Consideration

The proper safety methods should be taught in connection with the handling of each class of work. No man in any position should be retained in this service who does not respond wholeheartedly to the safety rules concerning himself and others. Safety depends largely on constant vigilance and careful organization to the end that each man engaged in the performance of whatever class of work he is doing, shall render such duty without placing himself in hazardous positions at any time. When handling heavy material, on and off cars, the one in charge alone should direct the work; more will result in confusion of orders and consequent accidents. When handling rails, or lumber material, on or off cars, trains should not be permitted to move any great distance without first seeing that loads are securely staked.

The loads should be carefully placed and should not be permitted to become over-balanced on either side. It is necessary to be very careful in removing stakes from cars loaded with material preliminary to starting unloading. Rails should be loaded in tiers and baled which will enable them to be handled much more safely and efficiently. Many accidents have been the result of improper protection of swinging booms on derricks and similar machinery when working across main line tracks. They should be afforded the same flag protection as a train when necessity compels their use in such manner. Careful inspection of all fastenings, cables, pulleys, etc., is, of course, necessary, and none should be continued in service where there is any question of their safety. Modern devices for handling heavy material are necessary to

That Mr. Donohoe entered actively into the affairs of the association after having become a member in 1910 is attested to the fact that he was elected vice-president only one year later and was re-elected to that office the following year and then advanced to the presidency, presiding at the convention in Chicago in 1914. The completion of this service did not cause him to cease his interest in the welfare of the Roadmasters for he has continued to be exceedingly active, in recognition of which he was elected treasurer in 1921, and has since served in that capacity.

T. F. Donohoe
Treasurer

insure a full measure of safety as well as efficiency and we recommend their use for both reasons.

Conclusions

Use local freight service when conditions are favorable and a saving can thus be effected.

Make use of motor cars with trailers where that method can be employed successfully for handling certain classes of material.

Self-propelled locomotive cranes can be used with economy in large material yards in place of work trains.

Work should be planned carefully to avoid the use of work trains during heavy traffic seasons.

Specify the class of cars for loading new material when purchase is made to get cars from which it can be unloaded most readily.

Choose train and engine men carefully as well as foremen and laborers for work train service. Where existing agreements prohibit this, it is recommended to railway managements that an effort be made to revise those agreements to permit the selection of the most capable men.

Require the conductor and foreman to furnish reports of each day's work.

The maintenance officer should outline each day's work for the train in advance, with copies in the hands of the engineer, conductor and foreman to avoid confusion and consequent delays.

Insist on adequate power.

Provide large tanks and water cars where necessary for locomotives and work train service.

Insist on engines being delivered on call from the roundhouse.

Secure proper cooperation between all departments involved.

Use power machines to reduce work train days.

Use double-end rail loading machines for picking up rail.

See that adequate capacity exists in air pumps for locomotives when working air machines.

Require safety in operation to reduce delays and prevent disorganization.

Committee: D. K. Newmeyer, roadmaster, S. P., chairman; A. M. Clough, supervisor, N. Y. C.; E. O. Carlson, supervisor, N. Y., N. H. & H.; G. H. Strople, supervisor, B. & O.; L. Coffel, supervisor, C. & E. I., and P. H. Burke, roadmaster, C., B. & Q.

Discussion

This report created active discussion. T. F. Donahoe (B. &. O.) and J. P. Corcoran (C. &. A.) emphasized the necessity of roadmasters watching the overtime expense of work trains in order to keep this from becoming excessive. They require work train crews to send them reports daily, which reports are checked for overtime and also to see that a proper amount of work is being done.

Other members emphasized the difficulty of securing a satisfactory output of work from crews which are placed in charge of trains under existing agreements with train service employes. J. B. Kelly (M. St. P. &. S. S. M.) urged the association to go on record in urging the railway managements to endeavor to secure a revision of existing agreements with train service employes to permit maintenance of way officers to exercise some choice in the selection of work train crews, and the report was amended to this effect.

W. S. Shea (C. M. & St. P.) emphasized the necessity of proper planning of work train activities and described the plan developed on his road whereby three work trains have been scheduled for an entire season, moving from division to division according to a plan prepared early in the season.

P. J. McAndrews (C. &. N. W.) stated that he has found that when his operating officers are shown the cost of the time lost by old or light locomotives, or those not properly equipped with air pumps, he has secured the equipment desired.

The Marking of Steel Rails

By C. W. GENNET, JR.

Manager Rail Inspection Department, Robert W. Hunt Company, Chicago

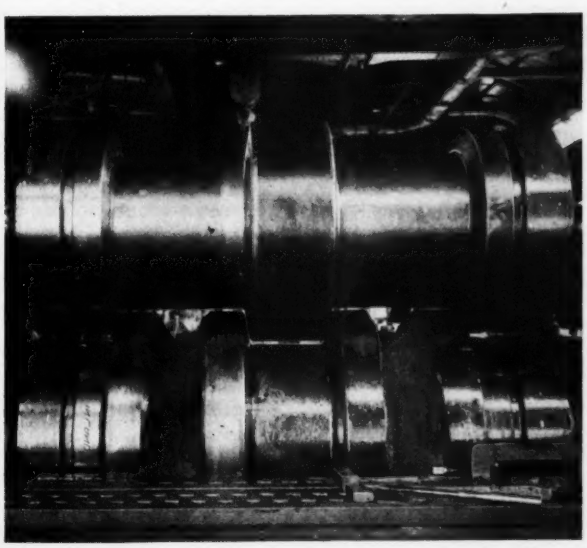
THE MARKING, or branding, of rails to enable those of one manufacturer to be distinguished easily from those of another was apparently done very early in the history of rail rolling. Even the oldest rails almost always bear some letters and figures, frequently permitting them to be identified as having been made at a mill long since dismantled and abandoned. To many in the middle west the letters N. C. R. M. on the web of a rail is still a familiar sight but the North Chicago rolling mill where those rails were rolled, not far from the heart of Chicago, was long ago turned over to other industries. English, French, German and American-made rails have probably always been branded. On the western plains, unbranded cattle and motherless calves are called "mavericks," and so with rails—unbranded ones, or those without a home, are properly classed as second quality.

It was of course a most natural thing that the name of the maker should be located on the web of the rail. That was always the best and easiest part of the rail on which to place the desired letters and figures. The only requisite to so doing was the necessity of cutting the letters backward into one of the rolls forming the finishing pass of the rail mill. Properly done, this method marked the rail for life and it has always been pursued and even extended so that for years nearly every form of rolled steel product has been branded with its maker's name. This of course permits one to identify the name of the maker of almost any form of steel easily for, regardless of the size of the finished article, as often as the roll turns round its imprint is left in raised letters on the metal.

Especially with rails, as time went on, it became important to know the approximate date of manufacture and as the multitude of different rail sections began to appear some means of distinguishing rails of a particular section also became important. Thus in the early days the year of manufacture was branded on with the maker's name and finally the month of the year. Also, either the name of the section or some symbol indicating both the section and its weight per yard were finally added to the brand. These matters are now all required by specifications. Perhaps the most outstanding exceptions in recent years to the customary practice of making the brands as brief as possible has been the addition at certain mills of the letters U. S. A., the meaning of which is well known and which, small matter that it is, puts even rails in the class with many other articles that now bear the familiar legend "made in U. S. A."

As mentioned above, the brand is always made by cutting the desired letters into the metal of one of the rolls. Necessarily the letters must be cut backwards. Occasionally mistakes have been made and various letters and perhaps the whole brand reads backwards on the rail. There are always two rolls forming the finishing, or last pass, of a rail mill and one of these rolls carries the brand. These rolls, generally of chilled iron somewhat similar to the surface of a cast iron car wheel, offer no little difficulty to the cutting on of the letters. It is generally a hand and chisel job but is often done by air tools. After one or two thousand tons of rails have been rolled and the surface of the rolls become worn they must be dressed again in the lathes and then the brand generally has to be redressed as well. It matters not whether the top or bottom roll carries the brand and practice was once quite diversified at different mills in this respect. The fact, however, that certain railroads lay rails with the branded side north or east led to some missionary work at the mills with the result that for several years all American mills have put the brand on the bottom roll and consequently the bottom side of the rail as it leaves the rolling mill is always the branded side. This is also helpful in determining which is the top end of the rail as rolled, for if the direction of the reading of the brand is known for a certain mill it never varies. Thus, when facing the brand of a Gary rail, for instance, and reading the brand from the left hand toward the right the left is the bottom end of the rail and the top of the ingot is toward the right.

Needless to say, cutting the letters into the metal of the roll makes a raised letter on the web of the



A Set of Rolls, Showing Brand (near lower left hand corner)

rail. Therefore brands always appear as raised letters and figures. The opposite is the case with the heat numbers. This number is stamped on the top side of the rail after it has come from the finishing pass and therefore it never conflicts with the brand which is always on the bottom side, although the figures of the heat numbers and the letters showing the ingot positions are actual indentations in the metal.

The two rolls of the finishing pass are easily adjustable in the housing, or stand of the mill. In fact they are frequently adjusted by the workmen to assure a good section. Not infrequently the rolls are separated a trifle more than at other times and then the brand or raised letters may appear "light," meaning that the letters do not protrude from the rail as much as they should. This may be caused by the setting of other rolls as well, and under various circumstances rails are sometimes rolled with very light brands, and perhaps none at all. Unbranded rails are made second quality.

The rolls are supposed to be set so accurately as to produce a perfectly symmetrical rail. This perfect

The Brand as It Appears on the Web of the Rail.

equality of the head is not always obtained and "lop-sided" rails result. As a rule the degree of lop-sidedness is slight but mill men and inspectors are constantly on guard for it and adjustment of the rolls

Old Brands

N.C.R.M.CO.STEEL, 1884
NORTH CHICAGO ROLLING MILL CO.
E.R.M.CO. 74-X ELMIRA ROLLING MILL CO.
MILL IRON 71-4 & 6 MILWAUKEE IRON CO.

Typical Brands

COLORADO SEC. 903 111111 1924 O.H.
O.H. TENNESSEE 9020 ARA-A 5-1924
O CARNEGIE ET U S A 1924 1 10020
R.A.A. O.H. 9020 ILLINOIS G 111111 1924 U.S.A.
A R A -A- 9020 O.H. INLAND U S A 1924 111111
100 RE BS CO STEELTON 11111 1924 O H
100 RA B S CO LACKAWANNA OH I 1924 100 ARA A

are easily made to overcome it. The condition, however, is probably partly responsible for various railroad rules requiring that the branded side of rails be laid north or east. It is of course understood that generally rails are never turned around end for end from the time of rolling until after loading. Thus rails on cars almost always have the brands all on one side. Some exceptions, however, are apt to make the lop-sided effect appear very bad in track after the passing of a few trains, although the unevenness soon disappears. Good judgment is the only tolerance for lop-sided conditions and practically no complaints arise from that source.

As already mentioned, specifications now stipulate thoroughly what the brand should consist of. The maker's name, month and year of manufacture and some description of the section and weight per yard are the essentials specified. Manufacturers have adopted a series of section numbers which usually convey the weight and type of section and common practice has more or less standardized this matter.

Altogether, the branding of rails is a simple expedient for conveying a vast amount of information. On the whole it is well done by all mills and they should be complimented on their efforts to harmonize the details and produce the results they do.

The number of the heat from which the rails were rolled is stamped on the top side of the web after the rails are sawed to length. This number is a series of figures arranged according to the particular mill's custom. The number is either preceded or followed by a letter signifying the position of the rail in its original ingot. Thus "A" is the top rail of an ingot, "B" the second, and so on. Occasionally another number is added to show the number of the ingot in the heat. This stamping is done by a machine arrangement in which the dies must be changed frequently and quickly. Naturally there is opportunity for mistakes or light stamping. The latter is due to the adjustment of the machine and consequently the whole process must be watched carefully.

The other marks put on rails at the mill consist of common prick punch marks on the web near the ends. Two such marks mean that the rail is second quality and its ends should be painted white. Three marks may mean a special class as required by some specifications. Various rails are also painted near the ends.

It rather seems as if some railroads failed to instruct their track forces thoroughly as to the meaning of the various marks and paints used on the rails. These naturally vary with different specifications and each road should take pains every year to see that complete instructions are issued to all section foremen, describing accurately what the various marks are. This procedure would greatly facilitate the proper handling of details later on.

How the Lehigh Valley Reduced Maintenance Expenses

By G. L. Moore
Engineer, Maintenance of Way, Lehigh Valley, Bethlehem, Pa.

WHEN I went on the Lehigh Valley the question of respacing ties to fit the joints became of increasing importance to me. We found one railroad system that required the rail ends to meet directly over the center of a tie. We found another system which required the rail ends to meet directly over the center of the space between two ties. On the first system they went to great expense to respace the ties when they laid new rail so that the rail ends would meet directly over the center of a tie, while on the second system they went to great expense to respace their ties to the spacing which the first system went to the maximum expense to get away from. Both of these roads had excellent track and we came to the conclusion that we would adopt whichever of the two standards happened to fit each individual joint best and save the expense of shifting ties. One of the first things we did, therefore, was to stop the unnecessary work and expense of shifting ties to fit the joints and devote this energy and the money to *productive* work. During this time efficient anti-creepers became available and we at once began to purchase great quantities of them, as we found that by applying them we could stop the creeping of the rails, and this made possible for us the non-spacing of joint ties.

Number of Ties Increased

We next began to consider whether economies could be effected by a stronger track construction. We soon came to the conclusion that there were not ties enough under the rails and as a result increased the number of ties in our heavy traffic tracks to 20 to a 33-ft. rail. This gave us 45 per cent of rail bearing on ties and still left room for the proper hand tamping of the ties. It is possible that we would have considered placing the ties even closer together if practical power tampers had been available at that time, but we hardly believe that there would be a sufficient gain to warrant a closer spacing especially if the stone ballast is kept clean so that the angular, interlocking shape of the broken stone retains the effect of transferring the loads upon an increased area of the sub-grade as compared with the area of the tie upon the ballast. To increase the number of ties from 17 or 18 to 20 per rail of course required the respacing of the ties. This work was done as the track was given a running surface at which time tie renewals were made.

In renewing ties we always, except in some special locations where the local conditions will not permit, give the track a running surface, renewing the bad ties without again respacing as they are now uniformly distributed. We have found, in the use of power tampers, that it is possible to raise the track not more than about an inch and thoroughly retamp it and thus overcome the effect of any center binding. We have also found that where there is sufficient ballast under the track it is advisable to raise the track as little as possible as it will stay in perfect surface much better.

Lay Rail in Winter

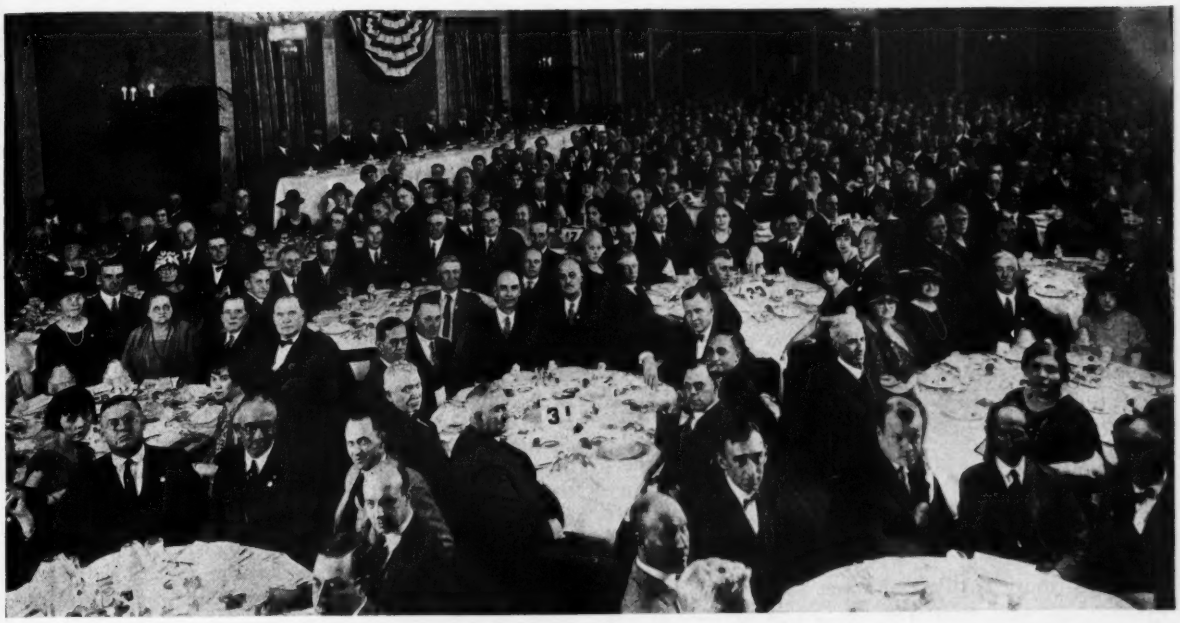
Now that we had good anti-creepers, and did not respace the ties to fit the joints we saw no reason why we should not lay new rail in the winter and thus, while directing the energies of the forces required to be carried through the winter to performing productive work, we at the same time relieved the summer forces of rail laying so that more work could be accomplished with the same force during the year. We found no difficulty doing this and no bad results. It is necessary to carry a light force to clear away snow and ice and take care of other emergencies that may arise, but it is of prime importance to employ this force on productive work just so far as you can and laying rail in the winter is one of the big items of productive work it is possible to do in that season.

We adopted the method of laying long stretches of track in one day by taking the track and running trains around. A little later we also began to lay rail with locomotive cranes. It has proved very successful and the officers of all departments interested would not consider going back to the method of laying rail under traffic.

Use a 136-lb. Rail

In 1915 we designed a 136-lb. rail section and laid the first 136-lb. rail early in 1916. This rail is 7 in. high, its base is 6½ in. wide and the section is otherwise of normal proportions. We were then using stone ballast and were fast approaching the time when we would have a sufficient amount under the ties; we had improved the drainage by surface ditching, widening cuts, placing subdrainage through cuts and had strengthened the track by building up the shoulders. Any further strengthening of the track had to be done by increasing the strength of the rail.

We had been stepping up in the size of the rail from 80 and 90 lb. to 100 lb. and some 110-lb. rail and came to the conclusion that we had better go at once to the size of rail which would meet our requirements for many years, if not permanently. We placed this rail on tie plates whose top was sloped to cant the rail in at an angle



Annual Dinner of the Roadmasters and Track Supply Associations on Wednesday Evening

of 1 to 20. We hoped to effect savings by reducing rail wear by using a heavier section with higher carbon steel; also having a big strong rail that would maintain the surface and line with the expenditure of less labor and that would distribute the heavy wheel loads over more ties and relieve the individual tie and thereby decrease tie renewals; to further reduce track labor we provided tie plates of economical design and long life.

We have obtained all of the results expected and in greater degree generally than we had hoped for. There is no such thing as spreading track on our sharpest curves. The average annual purchase of new rail in tons is less for the last eight years that we have been using 136-lb. rail, than in former years. The tie plates are proportioned by reason of the sloping top so that they are thickest under the outside edge of the base of rail where the greatest strength is needed and from all appearances will yield a long period of service.

The Use of Treated Timber Began in 1910

We began to use creosoted cross ties, switch ties and bridge ties in 1910 and now about 70 per cent of the ties in the track are creosoted. We have also used a great amount of treated bridge timber. There is no question in our mind but that the creosoting of ties and timber has produced a very great saving.

As soon as practical power tampers became available we started to use them. We began with the 4-tamper machines but after a little while we found economy in bunching two or three of these machines together in batteries and then the Ingersoll Rand Company, at our request, developed the 12-tamper machine that we are using today. The air compressors of the tamping outfits are also used to operate air drills, pneumatic track wrenches, pneumatic wood boring tools, cement guns, etc.

On the Delaware and the Susquehanna river bridges, with our present methods, we have replaced all of the bridge ties on one track of these bridges in one day by taking over the track and using locomotive cranes to handle the ties. The Delaware river bridge floor is 1,103 ft. in length and the Susquehanna river bridge is 1,808 ft. long. This same method has, of course, been adopted on smaller bridges. Also, where necessary to renew the track stringers of some of the steel bridges, a track a day has been renewed by the same methods, the larger part of the riveting being done on subsequent days.

We use locomotive cranes for screening ballast, the foul ballast in the track being dug out by hand and thrown between the tracks. The locomotive crane picks up all the foul ballast from between tracks to a depth of several inches below the ties and dumps it on the screen in a car. Gates are provided so that the clean ballast can be deposited on the track or to either side of the track, while the dirt falls in the car and is unloaded later by the crane. Stone ballast track cannot be economically or properly maintained if the ballast is allowed to become foul and it must be cleaned. This is a very economical way to do it.

We stopped purchasing crossing plank many years ago, substituting plankless crossings. The embankment shoulders have been built up with suitable material, ashes being generally used except along the rivers where light material would be washed away during high water. We believe the maintaining of the shoulder to proper height and width to be very important and we have given that work a good deal of attention. Stable track cannot be maintained with weak shoulders.

We have a large equipment of locomotive cranes which we use for a wide variety of tasks. A list that we made up a few years ago showed 66 different items of work which had been performed by these machines.

Our policies and methods generally may be stated to have been developed around the following principles:

Avoid unnecessary work.

Avoid unproductive work.

Direct the energies of the forces to productive work at all times and seasons.

Perform work in the most thorough manner.

Find and use the most economical methods.

Material Requirements Show a Decrease

Our average annual rail purchases in tons during the period of 1916 to 1924 inclusive, during which time we have been using 136-lb. rail only, is substantially less than the average number of tons of new rail purchased per year, going back to 1905 when the heaviest rail weighed

90 lb. per yard and there was considerable 80-lb. rail in use. During this same period the traffic on the road has increased very greatly.

The annual tie renewals have been decreased decidedly.

In 1920 the tie renewals were 116 to the mile.
In 1921 the tie renewals were 133 to the mile.
In 1922 the tie renewals were 77 to the mile.
In 1923 the tie renewals were 91 to the mile.

For the year 1924 they will be well below the 100 mark.

The average number of man hours chargeable to expenses in the years 1915, 1916 and 1917, or the so-called test period, were 10,496,749 hours.

In the year 1921 they were 8,776,115 man hours
In the year 1922 they were 8,776,115 man hours.
In the year 1923 they were 8,577,948 man hours.

This is 20 per cent less than during the test period. For the present year the man hours so far are running below last year.

The maintenance of way expenses for 1923 were $2,288.22 per track mile, including all items, and $1,426.55 for track items only.

The average expense per ton of revenue freight carried one thousand miles in 1923, including all items, was $1.36667 and for track items only $0.8521. The track items include only the charges to the roadway maintenance, ties, rails, other track material, ballast, track laying and surfacing, roadway machines, small tools and supplies, and removing snow, ice and sand accounts.

Report on the Handling and Disposing of Cinders

THE PROPER and economical handling of cinders begins at the cinder pit, although the direct and actual responsibility of the maintenance of way department usually does not begin until the pit is pulled and the cinders delivered. However, the final disposal will be handled more easily and economically if adequate consideration and attention are given to and at the cinder pit. Since the above is a recognized and conceded fact, the committee wishes to emphasize the importance of a properly designed pit and suggests to the department planning and designing new pits or overhauling old ones that the final disposal of cinders be kept in mind and every effort made to install a type of pit which will assist the maintenance of way department to handle the output economically.

When loaded directly out of water, cinders are expensive to unload in cold weather as they freeze almost solid in the cars, while if not properly wet in the pit, the cinders are likely to burn in the cars, damaging them. This burning also greatly lessens the value of the cinders as ballast, and the unloading is dangerous and expensive owing to the heat and dust.

Cinders loaded at pits of a type where they are thoroughly wet and then allowed to drain before loading, will not freeze so hard in cars, and are not dry and dusty, so that they are unloaded economically and used to the best advantage. These facts should be carefully considered when designing new pits.

In the actual disposal of cinders we face two separate problems, one where cinders can be used by the maintenance of way department for ballast, bank widening, etc., and the other where they cannot be so used to advantage and must be disposed of either as a waste product, or possibly in grading for proposed future tracks.

Track Layout and Equipment for Wasting

After careful investigation of various methods of handling the waste the committee makes the following recommendations:

(1) Locate the dumps as close to the point of origin of the material to be wasted as possible so as to avoid a long haul and enable equipment to be turned quickly. This tends to promote prompt unloading at all seasons and in winter permits the disposal of the material before it freezes.

(2) Construct an unloading track sufficiently strong and substantial to stand moving when lining over or raising.

(3) Establish a grade as much above the natural ground as possible, to permit the maximum disposal of material with the minimum throwing and lining of track.

(4) Provide modern equipment for handling, air dump cars of large capacity (20 to 30 yd.) are very efficient.

If cars that are not self-dumping must be used, a clamshell bucket or locomotive crane should be provided. A spreader should be used to level the dump and prepare it for the throwing of the track. With this equipment little labor is needed. Two men can clean out the cars when this is necessary, help handle the spreader, etc. The locomotive crane can often do the switching that may be necessary and so reduce switch engine expense. At least 500 cu. yd. of cinders can be disposed of daily with this equipment and layout.

Method of Unloading

As wide a shoulder as possible should always be made before throwing track, as a large per cent of the labor included in such work is employed in breaking loose and smoothing up the track. A few feet of additional throw is made quickly, and it is desirable to take the force off its regular work and assemble it to throw track as seldom as possible. If there is sufficient work to justify it, a mechanical track liner or shifter, such as is now on the market, should be used. The track should be kept up to the established grade at all times.

It has not been possible to secure accurate cost data covering the above work, as conditions and yardage vary so greatly, but from information available it would seem that from 5 cents to 15 cents per yard (not including haul and switching) should cover the cost, depending on the quantity and kind of material to be disposed of, the cost decreasing as the yardage increases.

An effective method where the yardage is great enough (possibly 50 cars or 2000 cu. yd. daily), and where the fill being made is high enough, is to construct a trestle and install a pumping outfit to wash the material from the cars. Several such plants are to be found in Ohio and Pennsylvania and are efficient and economical.

Another method which has been successful eliminates the trestle and uses long conveyors in extending the fill. The material is handled in drop-bottom cars, which empty the material into track hoppers, from which the conveyors, set at a small angle, dump the material at the bottom of the high fill. As the pile increases in height, the outer end of the conveyor is raised until the top of the pile is higher than completed

fill. These piles are then leveled to grade by a hydraulic stream. These same methods may be employed in unloading material used in making grade for future extensions, the unloading tracks being located and the grade established with the future plan in mind.

In some places cinders are sold for a nominal price or are even given away for the handling and are used for the building of driveways, walks, for filling, etc. The possibilities of such disposal are limited, but a saving is possible at times if proper effort is made. A judicious use of material in this way will often create and establish in a community, good will which is very much worth while.

More Extensive Use as Ballast

The committee is of the opinion that cinders can be used more generally for ballast than is being done at present. Excellent track can be maintained on cinder ballast, even where high speed passenger and heavy freight traffic are carried. Many roads are maintaining such track very satisfactorily, especially in the southern and western parts of the country, and there are thousands of miles of dirt track where conditions can be improved and the cost of maintenance decreased by the use of cinders. If necessary, a long haul is justified and cinders of even a poor quality will improve such track.

The quality of cinders differs, sometimes widely, on a system and even on a division owing to the kind of coal burned and the condition under which the cinders are handled. A study should be made of these facts and the better cinders used on the more important lines; assigning the lower grades to the lighter branches. In this way maximum benefit will result.

After the proper distribution has been decided on, the method of handling must be worked out. Here we face the problem of direct unloading or storage, and we must consider both. Where suitable equipment is available, the committee recommends that cinders be hauled from the pit and unloaded on the track where they are to be used, if the track is prepared and in shape for such unloading. They should be put under the track as promptly as possible after unloading.

Equipment for Handling Direct from Pit to Point of Use

For economical handling, equipment should be provided which is self-cleaning, and so constructed and maintained that the unloading can be controlled, distributing the quantity of ballast needed. There are several types of cars which answer this requirement. A fair capacity (30 to 50 cu. yd.) is usually desirable so as to justify a long haul. Cinders can be handled economically with a Lidgerwood and plow, where the quantity to be unloaded at one time is sufficient to justify such equipment. If 15 to 20 cars are to be unloaded at one time, and especially if 30 to 40 cars are handled weekly, the above equipment is suitable. With such equipment ballast can be distributed evenly. To secure enough yardage to justify this equipment cinders may have to be assembled from several points. This can often be done easily if an effort is made.

When only two or three cars are to be disposed of daily and where the equipment used is such that a small force can unload them quickly, it is frequently possible to have regular train service, such as local freight or roustabout crews handle the cars to unload, without running into prohibitive overtime.

When the quantity justifies it, however, the committee is in favor of a regular work train doing the unloading. The crew of such a train is generally more interested in the work than a local crew and the roadmaster should either be in charge himself, or have his assistant or a thoroughly competent foreman in charge. The economical placing of the cinders later depends very largely on proper unloading. This cannot be emphasized too strongly. The number of cars unloaded is not the only thing to consider when checking the day's performance.

Unloading cost data are hard to secure and vary widely, due to equipment, local conditions of traffic, and quantity handled. With equipment such as described above cinders have been unloaded for 2 cents a yard and the cost should not exceed 5 cents. Where hand unloading is done from dump and drop bottom cars the cost runs from 10 cents to 25 cents a yard. If cinders have to be shoveled over the top of the car, the cost has run as high as 50 cents a yard. None of these costs apply to frozen cinders, but to average working conditions.

The committee calls attention to the importance of proper distribution and urges that this be studied as local conditions must govern in each case. It is often possible to unload cinders on the more distant lines during the summer, holding the closer lines for winter unloading. This permits more prompt unloading, preventing freezing. Cinders can quite often be unloaded the same day they are loaded. The short haul is a saving in winter when all transportation costs mount.

Traffic on some lines varies with the season. Advantage should be taken of this to unload cinders as far as possible on the various lines at times when the traffic is lightest.

The Storage of Cinders

If cinders are to be stored a suitable unloading track should be arranged and ground prepared so that the cinders can be loaded again without picking up dirt and rubbish. The best method of unloading for storage is with a self-propelled clam-shell. This reduces labor to the minimum and curtails or eliminates switching crew expense. Cinders may be piled up with a clam-shell and a large quantity stored in a limited space. Later, when loading for use, the clam-shell should again be used. A caterpillar drag line has been found efficient and economical, as this machine can work alongside the cars being loaded without requiring a separate track. The cost of such storage will be from 5 cents to 10 cents a yard for unloading and the same for loading, not including cost of tracks. The cost of unloading on a track is, of course, the same as if unloaded direct from a pit under similar conditions and with similar equipment.

The disadvantages of storing are: (1) the cost of the two additional buildings, (2) the deterioration of the cinders while stored in large piles, and (3) the difficulty of finding unloading tracks and storage space in many terminals.

The advantages of storing are: (1) the prompt release of equipment, (2) the unloading before cinders become frozen so avoiding the excessive expense of unloading under winter conditions, (3) the assembling of large quantities of cinders that will be available later when needed, and when conditions on the line are most favorable for loading, and (4) the fact that proper equipment is more easily arranged for at some times than at others or when cinders are to be loaded out in large quantities or cleaned up in a short time.

The advantages and disadvantages should be weighed in each individual case as local conditions must determine the method to be used.

An arrangement offering all of the advantages and few of the disadvantages mentioned above is one which permits handling cinders direct from pit to storage pile by the same machinery which cleans and clears the pit. We mention this as it is a feature that should be considered in the location and design of new engine terminals. We do not emphasize it however as at few engine terminals can room be found close enough to the pit for such storage. This lack of space makes necessary the loading in cars at the pit and hauling to the storage pile and unloading, which adds to the cost as already noted.

Conclusions

Your committee recommends:

(1) That engine terminals and pits be planned carefully to aid in the economical handling and disposal of cinders.

(2) That cinders be used very generally as ballast on branch lines and given serious consideration as ballast for main lines.

(3) That when used for ballast, cinders be unloaded directly on the track, using modern cars and equipment, but one should insist that track be properly prepared.

(4) That if cinders must be wasted, suitable dumping ground, track and equipment be provided to handle them.

(5) That where conditions make necessary or justify storage suitable place for storage, track and equipment for handling shall be provided and that cinders be moved out of storage as promptly as conditions will permit to avoid unnecessary deterioration.

Committee: H. R. Clarke, engineer, maintenance of way, C., B. & Q., chairman; H. Q. Hamilton, assistant division engineer, B. & M.; G. G. Martin, assistant engineer, B. & L. E.; W. T. Hanley, division engineer, Penna.; H. Ferguson, superintendent of track, G. T.; J. Tierman, roadmaster, K. C. S.; T. E. Bliss, assistant engineer, St. L.-S. F.

Discussion

Discussion of this report centered largely around that portion relative to the use of cinders for ballast. D. O'Hern (E. J. & E.) opposed the suggestion of the committee that cinders be considered for use on main lines. H. R. Clark (C., B. & Q.) replied that there are many kinds of main lines and that cinders are entirely satisfactory for use on many of these lines, particularly on the western roads. The second conclusion was finally amended to read "That cinders be used generally as ballast on branch lines and given serious consideration as ballast for main lines, where other ballast cannot be employed more economically.

Report on Rail Laying and Ballasting

WITH the great increases in recent years in the length, gross tonnage and frequency of trains on trunk line railroads, necessity has arisen for the handling of all roadway maintenance work as far as possible without stopping or delaying trains. Estimates of the costs of stopping and starting a heavy tonnage train, including wear on equipment, fuel, wages and car delay, vary from $2.50 to $7. Where the delay is greater than that involved in simply stopping and starting a train the costs are greater. At the same time increases in rates of pay, shortened working hours and in some localities decreases in the average efficiency of track laborers have made it necessary that, for economical reasons, maintenance work be handled as efficiently and with as little delay from or interference with train movements as possible.

In such classes of work as rail renewals and heavy ballasting out of face where the track must be broken or temporarily made unsafe for train movement, flagmen must be put out, and, if the work is done under traffic, trains not only stopped but held, while the track force breaks the continuity of its work by stopping to connect up the track, make it safe for the passage of the train, and then stand idle while the train is passing. Where trains are frequent and heavy and their movement necessarily sluggish such conflict between roadway repair work and train movement adds greatly to the unit of cost of the work, and slows up the train movement. For instance, the hourly cost of a 50-man gang with one foreman and two assistant foremen (at 40 cents per hour for the men and 70 cents per hour for the foremen) is $22.10. Every time this force has to stop work, connect up track, stand back to let a train pass and then get started again it loses 30 minutes with no net results in completed work. Each such connection, therefore, represents a direct out of pocket labor loss of $11.05, for which no return is secured. Added to this is ordinarily a freight train delay of 20 minutes, adding at least 50 per cent to the above cost of making a temporary rail connection. Briefly, the above figures mean, therefore, that it costs over $16 to pass every train where rail renewals are being made under traffic.

These conditions have led certain heavy traffic lines to inaugurate the practice in multiple track territory of singling the train movements in both directions over one track during a period of several hours or the working day, in order to give the maintenance forces undisturbed possession of the other track for a sufficient time to complete large blocks of the work without train interference. Where three or more tracks exist this practice is simplified, but experience has shown that it can be done very advantageously on double track railway.

The practice followed in handling the train movements between the temporary ends of the double track varies. In some instances they are handled by dispatchers direct, in others by a pilot engine acting under absolute flag protection, or by operators or division supervisory officers located at each end of the single track section, in communication with each other, and handling the movements between their respective stations. Cross-overs, preferably facing point, where trains leave their own track and trailing cross-overs where they go back, are necessary. Where telephone dispatching circuits exist the work can be handled simply by placing portable telephones, connected with the dispatcher's circuit, at each temporary end of double track. Responsible officers located at each telephone with necessary flagging assistance handle trains over the section of single track between them. Through the dispatcher they keep in touch with approaching trains. The dispatcher need take no part in the detour movements except occasionally, on request, to hold a train back at a passing siding to prevent congestion ahead of a passenger train. It is advisable that trains be given information by train order or message about the detour movement before

The Electric Locomotive Attracted Considerable Attention on the Trip

R. L. Pearson (left), Engineer Maintenance of Way, N. Y., N. H. & H., Points Out Some Interesting Features

J. A. Droege, General Superintendent (at the right), and W. J. Backes, Assistant General Manager (third from left)

reaching the temporary end of double track, so that the train and engine crews will understand the proposed movement and avoid delays on account of misunderstandings.

In order to take full advantage of the opportunity to work without train interference it is advisable that a large force be assembled and as much work completed as possible while the track is free of trains. This is particularly true where the work consists of rail renewals, as very large forces can be worked to advantage. All preparatory work possible should be done in advance. It is the usual practice to distribute the rail and fastenings and assign one or more gangs for several days to getting everything in readiness for the actual operation of changing the rail.

Preparatory Work Must Be Done Carefully

Close attention must be given to the details of this preparatory work. Sometimes the new rail is accurately set up, fully bolted together, on the ends of the ties so that long stretches of it may be thrown in place and spiked after the old rail is thrown out. This, however, is feasible only on long tangents and is not the usual practice. The rail should at least be properly spaced and a pair of joints put on the end of each rail with one bolt loosely in place. Everything should be immediately at hand in its proper place. This includes bolts, spikes, tie plates, rail anchors, tie plugs, insulated joints, etc. The necessary short rails of proper length should be provided for breaking joints on curves. On tangent track where the tie condition is good it is permissible to unspike every other tie, driving plugs in the holes. Where adzing is to be done the work of the adzers can be expedited by going over the ties and starting a chip inside the rail on each tie. Before the track is broken everything should be done which can be done.

On the day when the traffic is to be detoured and the rail actually relaid the forces can be augmented by bringing in section forces or other gangs for from 10 to 30 miles in each direction on motor cars or work trains. They should be on hand ready for work when the track is actually broken. They must have the proper tools in good condition. It will be found that the heaviest part of the work is spiking and experienced spikers should be selected for this assignment. Mechanical devices must be used for setting the rail in place. Gangs of tong men are expensive and while they can work rapidly for short periods where rail is laid under traffic they cannot stand the strain of such work for six or eight continuous hours. Locomotive cranes are used by some roads with good results. There are on the market several types of small cranes, some operated by gasoline and others by hand, which do excellent work and will set in 100-lb. or heavier rail continuously at the rate of a rail every 30 sec., which is about as fast as can be done with locomotive cranes. With such machines it is necessary to spike each rail to gage at about two points as soon as it is placed so that the machine may pass over it. Where switches occur the leads may be cut and bolted together in advance and the switch put in with little delay.

It is of great importance that the roadmaster or supervisor directly in charge of the work devote thought to perfecting the organization and assignment of his forces in advance, so that there will be no confusion in getting the work started and no conflict between the forces. As his large force will be made up of many smaller forces, the foreman of each of the smaller forces should understand in advance what tools to bring with him and what his assignment on the work shall be.

No complete assignment of a force for such work will be attempted as local conditions will largely govern. It may be stated, however, that where a stretch of three miles of rail is to be laid one day and the work completed, full bolted and spiked, with rail anchors in place, joints bonded for automatic signals and the track ready for train movements at normal speed in 10 hours from the time the track is first broken, a force of 175 men with two rail laying machines should be ample. These men should be divided in two forces with 80 men with each machine. About 30 men should be ahead of each machine, pulling spikes, throwing out old rail, plugging and adzing ties and preparing the rail bed. Eight men exclusive of the operators should be with each machine to actually pick up the rail, place it and spike it in line. The balance of the force should follow, full bolting and tightening at least two bolts in each joint ahead of the spikers and finally full spiking. The 15 men in addition to the two 80-men gangs will attend to such details as putting on rail anchors, bonding joints, etc. Drilling holes for bond wires may be done before the rail is laid in track or, if power bond drills are used,

may be done after rail is in the track. Some lines on which the practice has been highly developed use forces as large as 150 men with each rail-laying machine and two or more machines on the same section. Ordinarily, however, such large forces are not available, even with the concentration of the rail gang and section forces for 30 miles in each direction. The writer has seen a stretch of 1,190 100-lb. rails with one switch laid complete in less than a ten-hour day, with a force of 160 men.

Mechanical Equipment Will Help

There are many devices such as pneumatic, electric or gasoline-operated track bolt wrenches, for tightening or taking off bolts, and drills, both track and bonding, which are very useful in such work, provided facilities such as air lines or compressors exist to operate them, but successful and economical rail laying can be done as described with the ordinary track tools. Some lines go further with the work and cut apart and load up all the old rail while the track is free, thus more nearly completing the job. This means more men and an extra work train and usually two additional locomotive cranes or rail loaders, but if the additional force and machines are available it pays to load the rail while the track is free of trains.

One line which was probably the pioneer in laying rail under detoured traffic has built up a very successful system of work by means of which it has laid as high as eight miles of rail in one day. This road uses locomotive cranes for setting in rails, power bonding drills and wrenches driven by pneumatic tie tamping compressors for drilling and tightening bolts, and additional cranes for loading the old rail. It estimates a saving of as much as $4 per ton in laying rail compared with the old methods. Such mechanical equipment, however, represents an investment of about $10,000 per locomotive crane. An outfit of four cranes with other equipment costs in excess of $50,000 and while it may be justified it is not available on many lines. There are, however, much simpler and cheaper machines on the market which will do excellent work. There is, for instance, a hand-operated machine costing about $450 which will set in 600 100-lb. rails or 500 130-lb. rails per day with five men. These are not theoretical figures, but indicate what the machine actually does. With two such machines and 200 men there should be no difficulty in laying at least 1,000 rails per day. A small, comparatively inexpensive, gasoline-driven bonding drill operated by one man will drill 500 bonding holes in eight hours.

This outline of operations is based on the assumption that where the rail is to be laid under a detoured traffic arrangement, the actual rail laying will be done on two or three days of the week, on which days the regular rail force will be greatly increased by other extra or section forces brought in from neighboring territory. Such an arrangement decreases the objections raised by transportation officers, as it reduces to a minimum the time in which operating routine is interfered with. The committee believes that it is the proper and most economical practice. However, the figures given in the fourth paragraph of this report on the cost of making a rail connection and passing a train over it show that, where at all practical, it is economical to detour trains for rail renewals where only the regular rail force is available. Where one train movement every hour is encountered the efficiency of a 50-man rail force will be increased 100 per cent if it works independent of trains, while the trains, with favorable cross-over locations, can be detoured over one track with less aggregate delay than is incident to the old practice of working under simple flag protection.

Some of the older track men are prejudiced against this method of handling rail renewals, believing that work done under such conditions with large forces must be done very hurriedly and poorly. As a matter of fact, work can be done much more uniformly where long periods of freedom from trains are assured. Where rail is laid under traffic poor work is likely to creep in during the hurry to make a connection to prevent delay to or to pass a waiting train. Where the traffic is detoured and the work continuous it can be so organized that each man or gang has a set class of work to perform, and the results obtained are more uniform than is possible where the disorganizing effects of frequent track connections enter.

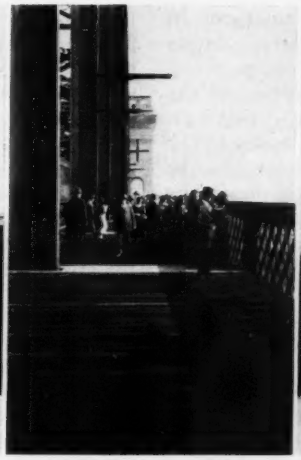
Large Economies Are Possible

The economies effected by laying rail under a single track arrangement are very marked. No detailed figures based on any one operation will be given, but we believe we are conservative in estimating a minimum saving of $2 per ton in the direct cost of completed rail renewals with rail of 100-lb. or heavier section. Where the traffic is dense the saving will exceed this considerably. In addition to this direct and measurable saving through a reduction in the cost of laying rail there is an indirect but no less real saving in the reduction of aggregate train delay. Where cross-overs are reasonably well located experience has demonstrated that trains can be detoured for a period of 10 hours with less aggregate train delay than occurs in one day where rail is laid under traffic. At the same time an amount of rail can be laid during this period of one day which would extend over a period of two weeks under ordinary methods of working under traffic. On a line of ordinary traffic density with an average of one train over each track an hour, we believe that the total train delay incident to rail renewals can be reduced more than 75 per cent by diverting the traffic while renewing rail. Where the practice has once been started, transportation officers, to whom rail gangs are ordinarily a source of annoyance, become enthusiastic believers in this method of laying rail on double track territory.

On some double track lines most existing cross-overs are trailing, but where a stretch of any considerable length of rail is to be relaid it is economy to put in the necessary occasional facing point cross-overs temporarily in order to detour movement for rail renewals. The actual labor cost of putting in and removing a temporary facing point cross-over will seldom exceed $250, which is properly a charge to the rail renewal expense, and which will be saved on each mile of rail laid.

The above described practice has generally been limited to rail renewal operations, but there is no reason why it cannot be used advantageously in the other major track operation of heavy ballasting out of face. Where such ballasting is scheduled with track lifts exceeding five inches it is the usual practice to skeletonize the track, make necessary tie renewals and distribute the ballast, and then raise the track. All tamping is done with square pointed shovels. On an average it takes as long to make a run-off and tamp up the track to let a train over as it does to make a connection in rail renewals and the work of a large gang may be delayed 30 min. thereby. Frequently poor tamping is done in the hurry of such an operation, resulting in irregular track later on. Any track

Roadmasters Leaving Float Bridge at Hunt's Point



The Train Stopped on the Hell Gate Bridge

Leaving the Train to Inspect the Van Nest Shops

man can appreciate how greatly it would simplify the work of obtaining uniform tamping, which is the prime requisite for good-riding, newly-ballasted track, to be able to work without interference from train movement. As track lifting is normally a faster operation than rail laying, the saving in train delay by diverting the movement would not be as great for ballasting as for rail laying; but even so, a sufficient saving would be affected to make it economical from a train movement standpoint.

Committee:—H. M. Smith, superintendent, N. & W., chairman; W. F. Nichols, supervisor, L. V.; William Shea, general roadmaster, C., M. & St. P.; G. W. Kohn, roadmaster, C., R. I. & P.; M. Regan, supervisor, C. & O., and J. A. Roland, roadmaster, C. & N. W.

Discussion

M. Donahoe (B. & O.) stated that he had found that it was not necessary to lay cross-overs to permit the diversion of traffic from one track to another, as the track can be disconnected and thrown over to form a connection in a few minutes at relatively little cost. He stated further that where the practice of giving a track over to the unrestricted use of a rail laying gang had been adopted on his road it was highly favored by operating officers.

R. H. Aishton Urges Study of Public Relations

R. H. AISHTON, President of the American Railway Association, spoke at the meeting on Wednesday morning in part as follows: At your convention held in Chicago a year ago you discussed the part to be played by the roadmasters in making a success of the program to provide adequate transportation. *Railway Engineering and Maintenance* offered prizes for suggestions as to how maintenance men could help to handle the peak load of traffic. Thirteen papers were submitted as result of that magazine's offer and were published.

The fullest use of equipment and facilities of our railways can not be secured unless delays to movement are reduced to a minimum. To accomplish this it is the duty of the maintenance of way department to see that every facility is capable at all times of standing up under the heavy demands placed upon it by peak traffic and in doing this to accomplish the work with the very least detention to traffic. How this end is to be reached is for individual determination. Various plans have been advanced, including workable seasonal programs, advance planned programs, attacking strategical points in their order of importance, attention to defect, etc., but all of them lead to the same end—maximum service with greater economy and efficiency.

Public Opinion Has Undergone a Change

The results of your efforts coupled with the efforts of every individual having to do with the operation and maintenance of the railroads in the last 18 months has brought about an entirely changed public opinion regarding this railroad situation. There were grave questions in the minds of the public two years ago as to the ability of the railroads to perform adequate service. These doubts have been entirely removed by what has been accomplished and today the transportation systems of America stand high in the public opinion as to their ability to provide transportation service at all times promptly, efficiently and well. In fact, one of the principal complaints we have had of late has been that freight reaches its destination so regularly and quickly that on arrival at destination it is unduly detained awaiting receipt of bill of lading coming by mail.

One of the large questions before the American public, and particularly that part of the American public engaged in agriculture, is as to the degree of economy with which the railroads are operated. You and I know from our close connection with the business that constant efforts are being made to produce better and more economical methods of accomplishing a given result. I doubt whether any manufacturing or commercial business in the country, and I know that no other transportation machine in the world, has shown the progress the American railways have in constantly introducing new methods, with consequent economies.

The trouble with railroad men is that they don't tell the public enough about what they are doing. You men in this room and the men who look to you for information and advice bear a responsibility in establishing the proper relationship with the public along your railroad as great or greater than any other class of men in railroad service. No other class of men in the service are neighbors, separated only by dividing line fences, with so many people, or such influential people, in this country as you are. The railroad right of way cuts through, or is

immediately adjacent to, a large majority of the farms in this country. The attitude of the owners of those farms and of their neighbors towards the railway companies is in a measure dependent upon their observation and the information they obtain as to the operations of that railroad from the man with whom they come in contact. The section foreman, the supervisor, the roadmaster all have a great influence on the attitude of these people in the conduct of their daily work and in the point of contact and touch with these neighbors of yours.

How Unfavorable Legislation Comes About

I want to cite an instance that comes to my mind. A number of years ago I was unfortunate enough to have to attend a session of the legislature of a certain state where a great deal of harmful legislation was being advocated. Among other bills, if I remember right, was one providing that where a farmer had 20 acres of land on one side of the track and the balance of his farm on the other side, an over or an under-crossing should be provided at the expense of the railroad company, high and wide enough to permit of the passage of a load of hay. After a lengthy investigation I found that the author of the bill was a member of the legislature, who had a farm with a hay field on one side of it with an ordinary grade farm crossing over the rails. The planks had become worn out and the approach had been gullied out. He had gone to the section foreman, told him he was going to cut his hay and asked if he wouldn't fix it up. He received a discourteous reply. The result was that this particular farmer used all the influence he had with the legislature to get his bill passed. If it had become a law it would have affected this particular railroad and every railroad in that particular state and would have cost millions of dollars, all because of a lack of appreciation of the duty, common sense, and rights of the public on the part of the section foreman. The bill did not pass but this particular farmer, and every other farmer on that particular line of railroad in that state, and I think on all of the other railroads, found his crossings kept up after that.

I have seen so many cases where a demand for legislative action to correct some difficulty is a result of some condition somewhere brought about by the failure of some officer or employee of a railroad to recognize and do what was evidently the proper thing. Inculcate "the good neighbor" idea into the minds of your section foremen and you will see a wonderful and most helpful reaction.

I have noticed the latest developments in your organization in the formation of local clubs of maintenance men. This cannot help but be conducive of constructive thought and action. Cooperation is essentially based on acquaintanceship and when you meet from month to month with the same men engaged in the same line of endeavor you cannot help but exchange ideas.

Developing the Canadian Pacific Rail Laying Methods

BY E. KEOUGH
Assistant Engineer, Maintenance of Way, Canadian Pacific

CONSIDERABLE has been written about the method of relaying rail on the eastern lines of the Canadian Pacific and for that reason it is not necessary to go into the details which have already been so well covered by recent articles in the issues of *Railway Engineering & Maintenance* of December 1923 and September 1924. I will therefore confine my remarks to our experiences with the various methods we have tried while leading up to our present practice. I fully realize the doubt created in many minds after reading about such performances when done at a distance and other circumstances which one is not familiar with. In carrying forward this work nothing other was done than the putting of the rail in the track. This alone was plenty for the day and force employed. It is also the one controlling item which governs the output of rail renewals. We consider that the trimming up work, such as tie plating when required, proper gaging, full spiking, should not be rushed but should be handled most carefully.

Our eastern lines consist of some 4500 miles of owned lines about 2500 of which are subjected to renewals with new material. During the past 10 years, 2500 miles have been relaid, portions of which having been done more than once during this time. Prior to 1921, the weight of rail was 85 lbs. and relaying was usually done by patching in where necessary. Naturally each subdivision was handled about in the same way as is customary with most roads under similar conditions.

In 1921, our standard was changed to 100-lb. R. E. rail with an allottment of some 500 track miles to be laid out of a face over three subdivisions between Montreal and Toronto. It was not possible to begin work on this program until the middle of September and even then the material came along at a rate not greater than 5 to 10 miles a day. Work was started first on a double track sub-division of 125 miles. This was done by working two gangs of some 300 or more men, completing the work as we went along with the exception of switches which could not be done at the time owing to the lack of material. Locomotive cranes were employed with tong men working on the inside rail where the walking was good. Such organizations gave us from 2½ to 5 track miles per day, as a maximum.

In order to expedite the placing of the rail, additional tong men were tried out immediately ahead of the machine and these set in a rail each time the machine did. This increased the speed some 15 to 20 per cent but was not entirely satisfactory, owing to the fact that no preliminary rail placing had been arranged for.

The first 250 miles was completed in this manner, however, and it was here that we noticed the extra amount of regaging and lining necessary to put track in proper shape for the winter. This sub-division was practically tangent, and as the weather kept open, sufficient time was found to do the necessary follow-up work in at least a temporary manner.

Track was singled throughout this job much to the detriment of the train service which was heavy at the time. Our work trains picking up old and unloading new material were also seriously handicapped by having one dead track and one too much alive to work on.

On reaching the next sub-division which was mostly single track with fairly heavy curves, it soon became apparent that we needed to watch our step as the winter was drawing near with not enough time ahead to reline the track and leave it in fit shape for full and safe speed. A change was made by tie plating one side only and this was followed until light snow and sleet storms made tie plating practically prohibitive. It was found that although our 100-lb. rail when laid both from inside tightened the gage ⅜ in. theoretically. This usually was of no consequence for in actual trial it was found that the

gage was about as desired.

The balance of this track (about 200 miles) was finished by placing both new rails from inside and spiking alongside the edge of old tie plates. All inside spikes were applied and the track continued in this condition until spring when the tie plating was done by smaller gangs. This single track was done by working four to six gangs a few miles apart. No preliminary work was done and gangs of 150 men were able to do as much as three miles as a maximum.

It quickly became apparent, however, that the roadmaster and dispatchers were being kept exceedingly busy. Camp outfits had to be moved every night with the men badly disturbed and the traffic obstructed. The roadmaster usually knew all about one or two gangs but had only a vague knowledge of the conditions at other locations. We then decided that with any further work, everything possible should be done to concentrate the work so that a sufficient quantity of rail could be laid at one location to complete an ordinary season's program in due time. Rails coupled in pairs were tried out experimentally in 1922 with good results and in 1923-1922 with good results and in 1923, 100 miles were laid in this manner as described in the December, 1923, issue of *Railway Engineering & Maintenance*.

The proof of the pudding is in the eating. We find our trackmen and operating officers enjoy the work and it gives us excellent returns. We are not employing any new methods to speak of but have merely combined the experiences of others. Our forefathers secured excellent results by laying rails in strings and no doubt a majority of you have. Due to the fact, however, that careless workmen distorted the expansion allowances in relaying curves, this practice was discontinued by going to the single rail laying method.

My contention is that we have swung around to the other extreme and that we do not require expansion shims at every joint while relaying rail but in place should make certain that the right amount per mile is allowed and that summits are laid tightly and sags loosely.

Report on Methods of Increasing the Output of Maintenance of Way Labor

YEAR by year the relations between employer and employee are becoming better. This does not mean that the gap between labor and capital has been bridged or that it is soon likely to be but every agreement as opposed to strikes pushes the bridge further across the chasm. These contractural relations tend to make labor more satisfied and reduce the labor turnover. The advantage of a small labor turnover is brought out in a recent study of the methods of selecting and placing employees, the results of which have just been published by the United States Department of Labor. It was found, for instance, that the output increases steadily with the length of service and that about two-thirds of the work is done by employees who have been in the service from 10 to 20 years. Poor quality and low production are found among the workers whose terms of service are short.

The employment situation in the maintenance of way department, particularly as it affects the track forces, is admittedly unsatisfactory. The men now recruited for this work are largely of a type that does not make for effective results. But even more serious is the fact that it presents an unfavorable field from which to select capable section foremen. The foremen is the key man. He must shoulder his full share of the responsibility if something goes wrong. It is considered most difficult for the foreman to share both blame and praise with his men but the man who does this will have discovered the secret of managing men.

A foreman must also have magnetism. All are familiar with the fact that certain women have the knack of dressing well and of furnishing their homes well on an expenditure far less than those of sisters more fortunate financially, but less fortunate in their purchasing powers. So it is with foremen. To be successful they must hold down the labor turnover.

Hoover on Employment

Herbert Hoover cites intermittent employment as the greatest of the three largest wastes in production. The investment in railway employees would pay better dividends if better men could be attracted with reasonable assurance of steady employment.

Mr. Hoover places as the second greatest waste in industry, unemployment that arises from shifting industrial relations. This is overcome by a balanced labor organization with no predominance of any class or department, and, other things being equal, with possibility of going to the top, acquiring knowledge and experience as an employee passes through each stage. This unites all the interests of management, employee, the public and the investor. Henry Ford says "The main task is not to get dollars but to give service and service comes by training and experience. If the service is rendered the dollars will come. It is sheer waste to dismiss a well-trained employee if it is possible to retain him because in so doing you automatically throw away your investment."

Mr. Hoover characterizes the third waste as due to strikes and lockouts. This is remedied by the method in effect on one large railroad system which has for its basis mutual confidence, facts mutually established and joint conferences of employer and employee to determine what the facts mean and how they shall apply. It means the adoption of a practical common sense understanding that the best way to settle disputes is to trust each other, to find out what the facts are and then to sit down around a table and talk them over in a frank and friendly fashion. This means employee representation in management and insures a square deal and a real spirit of co-operation. Last but not least, consideration must be given to proper housing conditions. Clean efficient labor demands a comfortable healthy home.

With labor satisfied, we must have organization. The foreman who is pushing his men does not necessarily prove that the method by which he is accomplishing given results is the method by which he can accomplish maximum production in the minimum time. Every foreman endeavors to accomplish the same results, but their methods are different. That is reflected on their sections. Nine foremen out of ten are interested in knowing how the other fellow does his work. This very fact makes the foreman more alert and more eager for better performance. It is then the plain duty of the supervisor to make a comprehensive study of ways to co-ordinate and systema-

tize their methods, which will reflect immediately on the balance sheet.

Recommendations

The recommendations of the committee are:

First: Permanency of employment without lay-off days and indefinite furloughs.

Second: A graded rate whereby men who remain in the service three to five years will receive a higher rate than new men.

Third: The adoption of a piece work basis for certain kinds of maintenance of way work only, but the rejection of a bonus as allowing a rate higher than the basic rate.

Fourth: The adoption of labor saving devices as rapidly as authorizations permit.

Labor Saving Equipment

We know that where mechanical labor saving devices have been placed in competition with hand labor they have demonstrated their superiority ultimately, but it has been only in the last few years that labor saving devices have been applied to new work. Approximately 65 per cent of maintenance of way labor is applied to roadway and track; thus it offers the greatest chance for labor saving devices.

The April, 1924, report of the Department of Labor on Immigration and Railroad Labor Supply is authority for the statement that considerable progress has been made by the railroads in the use of labor saving devices in the last few years. However, this development is still in its earliest stages. Approximately 450,000 men are required to maintain the tracks and structures of the railways of the United States. In a paper presented before the Western Society of Engineers, at Chicago, two years ago, Robert H. Ford, assistant chief engineer of the Chicago, Rock Island & Pacific, stated that approximately 360,000 of these men performed work that some day will be done wholly or in part by mechanical means. As we are all familiar with the numerous labor saving devices on the market, their cost, savings, etc., this report will omit special reference to those things being done on most of the large roads as approved practices and which have been described in engineering magazines, pamphlets, etc. Attention will be given to the organization and working force for special operations.

The Practice on One Road

A supervisor on one of the leading systems writes: "As far as our own experience goes, we believe that maintenance work can be handled most economically in the following manner:

(1) During the winter months the foreman and the supervisor go over each section in detail and from their knowledge of track conditions on that particular division, decide upon the major items of maintenance work to be attempted during the following season. After reaching a decision on this point, the work should be scheduled and reduced to writing, each foreman being furnished with a copy of the work which is to be attempted on his section and the supervisor and assistant supervisor having copies of the schedules for the entire division. When this is done, all concerned know exactly what they are going to try to do during the year.

(2) During the winter the heavy items of track material, particularly ties and switch timber, should be distributed where needed in the order of the work scheduled, unloading the material directly from the cars in which it is received onto the ground where it is to be used, in order to avoid the expense of extra handling.

(3) Every effort is exerted to give each foreman an adequate force and help him keep his gang filled up so that he has a chance to accomplish the work expected of him.

(4) The foremen are encouraged in every way possible and their good will and co-operation secured by fair treatment and by consideration in the little things that mean a lot to them and that at the same time do not interfere with the work or with the maintenance of proper discipline. In other words, a supervisor should make his foremen feel that theirs is an exacting occupation and that anything he can do to make working conditions better and add to their comfort and pleasure, within reasonable limits, will be gladly done. Make the foreman feel that he is the absolute boss of his own section and sustain him in every way, as long as he is fair with the men.

(5) The handling of heavy repair work, such as the renewal of switches and rails and new construction work, should be done as far as possible by floating gangs, the section men being permitted to work continuously on their regular maintenance work with a minimum of interference. In other words, keep all extra work off the section foreman so that he can proceed with his maintenance work.

In actually performing the work, we take advantage of such up-to-date tools and appliances as have proved econmical and successful, as far as we have been able to secure them. The following are in very general use on our system:

A. Pneumatic rail loaders.

B. Ditchers, working in pairs, for the cleaning of ballast in intertrack spaces.

C. Motor cars for section men.

D. Locomotive cranes for handling rail, switch timber, frogs, switches, screenings, coal, and other heavy material in the maintenance of way storage yards; a crane and operator with three laborers performing the work formerly done by the work train outfit and 20 men.

E. Pneumatic tampers for use in tamping track at interlockings and other points where traffic is severe and where it is impossible to do proper tamping with the ordinary tools.

F. An oxy-acetylene shop for repairing frogs, switches and other items of track material and for the cropping of rails (for use in track, and also the cropping and building up of rails) in track without removal.

G. Pneumatic drills for drilling bolt holes, etc., in track work.

H. Portable pneumatic grinders for use in grinding out throats of frogs, lips on stock rails and surfacing rail heads at points where compromise splices do not bring the tops of rails perfectly level, particulary in high speed passenger tracks where a full head rail for new frogs and switches must join worn rail.

I. Milling machines for use in milling out stock rails to protect switch points from wearing, insuring additional safety of operation.

J. Pneumatic bolters for bolting up joints when laying new rail.

K. Pneumatic reamers which are really pneumatic bolters with special fittings for use in reaming out holes in switch rods and lugs for the installation of oversized bolts to avoid the renewal of switch rods and lugs.

L. Steam ditchers for unloading refuse, etc., on regular dumps.

M. Dump cars to handle refuse at points where they can be used.

N. Substitution of one-piece guard rails for standard guard rails in order to eliminate the expense of clamps.

O. Tie plates on all ties where traffic conditions justify their use.

P. Treated ties and switch timber at all points where their use will be economical.

Q. Substitution of oil or bituminous materials for old

style plank crossings when renewals are necessary, renewing the rails, ties and connections within the crossing limits with new material at the same time.

R. Elimination of particularly bad soft spots or bad bottom in the road bed by special drainage methods to eliminate excessive maintenance charges for surfacing, etc., at these points.

S. Sodding or similar treatment of slopes in cuts to eliminate slides and the expense of ditching.

We believe the following appliances and methods for the handling of snow will save money:

(1) Use of gas and electric heaters at points where they can be installed, snow melting oil and snow pots, flangers, etc.

(2) Set up a regular program each fall before the arrival of winter, so that each supervising employee in the organization knows exactly what to do in case of a storm.

(3) Arrange with local contractors and others, where possible, for extra laborers in case of severe snow storms, in order to avoid calling out expensive mechanic and other highly paid men for snow storms, particularly at terminal points.

(4) Where possible to do so arrange with local restaurants to feed the men called out on account of snow, instead of depending on commissary cars.

Occasionally during severe winters with heavy snows, the intertrack spaces become filled up with as much snow as they will hold, while the tracks are also full to the top of the rail, so that in case of a further heavy snow, the road would be practically tied up, there being no room to throw the additional snow. In this case, which is exceptional, use a spreader to flange and spread the snow from the tracks and intertrack spaces so as to make room for more snow.

How One Road Organizes to Lay Rail

An officer of one of the Canadian roads writes:

"The outstanding opinion seems to be that close supervision by officers directly in charge of work is paramount. Supervisors or roadmasters should not be given territory too extensive to enable them to come in direct contact with their men and their work at frequent intervals and they should even be able to organize and supervise extensive programs, such as rail renewals and ballasting.

I have found that these two items of work can be so thoroughly organized as to make them standard jobs instead of splitting them up into smaller units and thus allow each foreman to carry out his individual ideas alone. By being properly organized, large units will find there is much work that can be done in advance of the actual breaking of track. For instance, it is found that when sufficient preliminary work is done in advance of rail renewals, the output per man can be increased over that of smaller units. This is found to be due to the fact that men walk over the track but once while performing their individual duties.

Once a large job of this kind is put on a working basis, it becomes sufficiently important for all officers on a division to interest themselves in it and usually brings forth friendly rivalry, which produces results. By making use of labor saving machines and tools, together with the completion of all necessary preliminary work on relaying work, we have now arrived at the time when 100-lb. rail is being placed (by disturbing one line of spikes only) at a rate of a mile for every 25 to 30 men per day. It is also found that these larger units require but little more organization than the smaller ones.

Preliminary work is possible on many jobs and for such jobs as ballasting or rail renewals is a great aid to the operation of trains. We should, therefore, do no part of these jobs while track is broken that can be arranged for otherwise unless the traffic is very light. On ballast jobs all tie renewals, including those in inaccessible places like crossings, should be made in advance of the lift. The subgrade may also be prepared, spikes driven home and every rail length of track be made exactly alike for the ballast gang. By so doing there are no "snags" for the regular gang to strike. The same applies to rail renewal jobs. A survey should be made in advance to see what actual conditions prevail with the old rail. Often one finds a curve tied up with hardwood ties while the tangents are provided with soft wood. This will make a tremendous difference with the claw bar men for there will be either too many or not enough men on the bars. Also many stretches of track will be found where old bolts are hard to unscrew. Slot spikes are often throat cut and hard to draw. These conditions should be given attention in advance by a special gang prepared to handle the situation rather than to hold up a gang of men watching one man pull a spike or loosen a joint for a closure. Joints can be broken in advance and be replaced by free-running bolts, washered up to insure quick work in taking them apart.

With work thus properly arranged each man in this larger organization will realize that his duties are regular and he will find his work much more pleasant. Where rails are placed by tong men, there is nothing more discouraging than to be compelled to carry rails extra distances. The utmost care must be taken to see that rails are not only set up properly in advance but also unloaded evenly.

There are also too many irregularities in performing even the more simple operations of track work. Tie renewals alone are often handled on the same sub-division by various methods. There is usually a "best way" for any particular sub-division and unless a single process is being followed supervision is lacking. Whenever physical conditions will permit, considerable labor can be saved by taking advantage of work in every manner possible.

Earlier track construction in this country usually called for earth ballast sections. The track centers were rounded high above the ties and the ends of ties were cleared for drainage. This practice of filling the center first and leaving the remaining material for the shoulder still exists and is a habit well worth checking. Now that we have porous ballast which does not shed water as our original earth ballast did, we do not require this material in the center of track. A heavy shoulder without center filling is of especial advantage in most climates for spring conditions as it allows frost to escape from the center of the track first and at the ends of the ties last, which condition is ideal for stability. This practice has been tried out recently on both northern and southern roads with good success. It is a practice well worth considering, for it will save the railroads thousands of dollars and also improve working conditions for the trackmen.

A Letter from the Secretary of Labor

In conclusion, we quote from a letter received from the Hon. James J. Davis, Secretary of Labor, as follows:

"The only suggestion that I could make would be the co-ordination of the head, heart and the hand, in other words, a conscientious service of sixty minutes to the hour, in which common sense as well as manual strength is applied. Especially at this time when for

the welfare of the institutions of America we feel the need of assimilating the large number of aliens now here before admitting millions more, it is necessary for American labor to develop labor-saving devices to such an extent as to obviate the necessity for a larger number of foreign labor. Needless to say, to get the most out of a job, one must put his heart as well as his energy into it. There is no panacea for labor's ills."

Committee: A. E. Preble, supervisor, Penna., Paoli, Pa., chairman; W. H. Saltzman, supervisor, Penna., Ravenna, Ohio; E. Keough, assistant engineer maintenance of way, C. P. R., Montreal, Que.; J. W. Powers, supervisor, N. Y. C., Rochester, N. Y.; C. L. Elliott, roadmaster, Ft. W. & R. G., Brownswood, Tex.; J. B. Kelly, assistant general roadmaster, M., St. P. & S. S. M., Minneapolis, Minn.; W. A. Moberly, roadmaster, C., M. & St. P., Elgin, Ill.

Discussion

The discussion on this report was devoted almost entirely to the question of laying rail with tong men, with manually operated machines and with power machines. C. W. Baldridge (A. T. & S. F.) stated that it was uneconomical to handle heavy steel with tong gangs or with manually operated equipment, and recommended the use of power equipment wherever it could be secured and used. He reported that one of the shortcomings of the manual equipment was the small radius over which it could operate, thus tending in many instances to require several moves in handling one rail. He also thought that rail when picked up should be set in track on the first move, rather than set down on the end of the ties, as this would obviate duplicate handling. It was pointed out by E. Keough (C. P. R.) that the efficiency of manually operated equipment used for setting up rail was greatly dependent upon the accuracy of and the care taken in the unloading of the rail. He stated that the plan of setting up the rail just on the end of the ties and then setting it in track later greatly speeded up the work as a whole. As an example of the effect of careful unloading, he stated that, depending some what on the territory, small forces of from 5 to 15 men and one machine set up about 5 miles of rail per day while larger gangs would set the rail in track at the rate of from 5 to 15 miles per day. It was stated by other that conditions of territory and track were an important factor in determining which method of handling rail was to be preferred, the general consensus of opinion being that in all methods, it was extremely desirable to make an accurate placing of the rail when unloaded.

Maintaining a High Degree of Line and Surface

By W. J. Backes
Assistant General Manager, New York, New Haven & Hartford, New Haven, Conn.

WHEN I was asked to address you I was prompted to accept largely by a thought which came to me through a statement made by one of our supervisors as to the possibility in the future of maintaining the high degree of line and surface that was the case prior to the war. I felt that it might be of interest to you to know the feelings of some in regard to this matter.

As you all know the greatest element lowering the standard of maintenance during the war period was the lack of proper labor. The situation has improved somewhat, but it is still subject to the migratory habits of the laborers which they acquired during this period and which is evidenced at the present day. When business is good and industry is working to maximum capacity, the better class of labor seeks employment elsewhere than on the railroad. When business is slack these men come back to our employ. Consequently the efforts of all concerned are spent largely in continually training a lot of new men. This has had a tendency to discourage the section foremen and it is only through the enthusiasm and loyalty of our supervisory force that we are able to hold our own.

Mechanical Equipment Forms an Important Asset

Much can be accomplished in overcoming the inexperience of laborers by using mechanical devices whose performance does not depend so much upon the individual skill of the operation. Furthermore all devices that eliminate the handling of heavy weights as for instance the use of motor cars and devices to perform the more laborious operations of the men, have a tendency to overcome the inefficiencies of the men and to make this work attractive. The benefits to be obtained through the use of labor saving devices can only be attained to the fullest extent by thorough organization. This is a matter that the supervisory forces must give the closest attention. That we will have a marked shortage of labor to face for a number of years to come, is generally accepted, without question, at least by officers responsible for the maintenance of railroads situated largely in industrial territory. The situation has been aggravated materially within the last few years by the restrictions placed upon immigration and apparently a modification of the law that will improve conditions cannot be expected for some time to come. This makes necessary the adoption of track appliances and labor saving devices that will reduce the labor demand to a minimum.

The use of rail unloaders and hoists has materially helped in reducing the amount of heavy lifting to be done by the men. The use of tie tampers has reduced to considerable extent the hard work of tamping track. The use of motor cars has relieved the men of pumping hand cars to and from their work, resulting, not only in saving of time, but in having the men in better condition to work when they get on the job.

The use of better and heavier material has also reduced to some extent the amount of labor necessary to maintain good line and surface. There is every reason to believe that the use of tie plates of generous dimensions on creosoted ties will materially reduce the disturbance of the track for tie renewals, lining and regauging of track, and give a consequent saving in labor. With the use of a high girder section of rail, which will distribute the load over more ties than at present, and which will provide for generous fishing space for the angle bars will assist very materially in reducing the number of low joints and the consequent necessary labor. It is thus reasonable to anticipate that a material reduction in labor can be made in this way. It therefore behooves the maintenance of way department to study the methods of proper organization to obtain maximum results from our labor saving devices, and also to study thoroughly and carefully the materials that go to make up track structure. This will assure on the one hand that efficiency is obtained from the mechanical appliances through proper organization; and on the other hand, that the rigidity of the track structure obtained through the use of heavy materials and also that the permanence of the structure are maintained.

Labor saving devices and better materials cannot be

obtained upon the railroads unless we can clearly demonstrate the economies and efficiencies to be derived from their use. In the case of the work equipment, the experience that has been had in the past indicates that where the use of these devices is properly organized we can show marked economies and it will be those who develop the methods of organization to obtain these economies, that will be provided by their managements with such equipment. This is also true of the heavier track materials. It is very imperative that the weight of track appliances be increased to meet more nearly the increased loads which the railroad structure is required to carry. Axle loads have been increased to a very marked degree. The repeated blows given to the track structure by long trains of coal cars loaded to capacity is about as destructive an element as we have to deal with. It is not fair to expect that a track structure which was adequate 20 years ago, should carry these loads without some indication of grief. A heavy track structure somewhat nearer in proportion to the loads being carried, should affect a marked saving. On the other hand the authority to obtain these materials from the managements can only be had by showing actual economies. I am firmly of the opinion that it is possible to provide track with as good line and surface as we had prior to the war, provided a heavier track structure is built and advantage taken of the many devices which increase the efficiency of the men.

One of the most serious blows to the maintenance department has been the change-over from the ten to eight-hour day. We are attempting generally to perform the same amount of work with the same or a less number of men than we had prior to the war and with a 20 per cent reduction in the working hours. The performance that has been made in maintaining track under these adverse conditions, gives great credit to the supervisory officers of the maintenance of way department. I believe the spirit of our supervision is as strong and willing as it ever has been, in spite of the many difficulties which have been encountered in attempting to carry on their work. What is needed is a higher degree of organization in connection with the handling of the work, and heavier materials to withstand the increased loads passing over the tracks.

Report on the Possibilities of Winter Track Work

IT IS EVIDENT that this question is not important on Southern lines, while the possibility of doing most kinds of track work during the winter months in the extreme north is very limited. However, there is a large railroad mileage in the middle zone where certain classes of track work can be done equally as well and as economically during the winter months (November 1 to March 1) as at other seasons of the year, and it will prove advantageous to do such work during these months. In making this report your committee is therefore only taking into consideration the middle zone.

One of the principal reasons for wishing to do track maintenance work during the winter months is that a much more adequate labor supply is available at that time on account of the fact that such industries as agriculture, lake navigation, highway construction, etc., whose work must be done when the weather conditions are most favorable, are then practically at a standstill. Conditions of labor supply vary in the middle zone according to location. There are places where there is always plenty of native track labor; there are other places where there is scarcely any native track labor during the summer months but plenty during the winter; while there are still other places where there is no native track labor at all during the summer months and an insufficient supply of foreign labor at that time, but many track men seeking employment during the winter months.

The following kinds of track work can be done equally as well during the winter months as at other times of the year:

Rail renewing.
Frog and switch renewals and repairs.
Track gaging.
Angle bar renewals and bolt tightening.
Railroad crossing renewals and repairs.
Tie plating out of face.
Cross and switch tie unloading.
Rail sorting, material reclamation, etc.
Cinder unloading, bank widening, etc.
Fencing.
Certain ditching operations.
Sewer and drain pipe installation and repair

as well as numerous other jobs that do not necessitate working ballast or lifting the track. It is true that some changes in the manner of doing the work will have to be made. For instance, track fastenings can not be distributed much in advance of rail laying, as they will freeze to the ballast, or be covered with snow. Track where rail is to be laid will have to be cleaned before frost enters the ballast, to avoid picking frozen ballast to apply rail anti-creepers.

A number of railroads in the middle zone have laid a considerable amount of rail during the winter months the last six or seven years, as they are experiencing considerable trouble in securing men enough to complete their work during the summer. We have been unable to find anyone who has made any extensive studies to determine the difference in the cost of laying rail during the winter months as compared to the summer. During the past winter one of the large railroads in the middle zone laid 6,000 tons of 100-lb. rail, replacing rail of the same weight and pattern in multiple track territory, trains being detoured over the other track so that the track gang could have the uninterrupted use of the track on which it was working for five to six hours. This gave the gang some time to prepare the track before laying rail was actually started and some time to finish after the rail had been laid. A locomotive crane was used to pull out the old rail and set in the new, the rail on both sides being changed as they went. As the same tie plates were used, the inside spikes only were pulled and the rail was drawn in with the crane. As there was frost in the ground this operation did not disturb the ties, although considerable more care would have to be taken in pulling the rail in with crane in the summer when the ties are loose. This road reports an average cost of laying of $2 per ton, with some as low as $1.60 and others as high as $2.40. Angle bars, bolts, nut locks, spikes, rail anti-creepers and short lengths for curves were carried on cars behind the crane and were distributed as needed to prevent them from being lost in the snow or frozen to the ground. By getting this work done in the winter this road had its gangs as well as its cranes available for other work in the summer.

There will be times during the winter months when none of these jobs can be done on account of extremely cold weather or snow storms, but the men would then be available for work occasioned by the bad weather.

At such times it has otherwise been necessary to hire a number of new men at much higher rates of pay. The time lost in the winter months would be no more than that lost on account of rains during other seasons. If work that could be done during the winter months would be deferred until that time, it would do away to a considerable extent with the practice of putting on as many extra gangs of inexperienced men during the summer months as the gangs used on this work during the winter would be available for ballasting, tie renewals, surfacing and lining, and other jobs that must be done when there is no frost in the ground. This plan will also provide for the continuous employment of all forces, thereby attracting good men. Continuous employment is the greatest factor in getting and holding good men. Experienced, contented men greatly reduce the number of man hours necessary to do a job. It would also have a tendency to stabilize wages, as it would practically eliminate the present practice of railroads recruiting additional maintenance gangs when other industries are taking on men and offering them numerous concessions that railroads can not offer.

By doing the jobs that can be done during the winter months at that time, a full season is left for tie renewals, ballasting and surfacing with a consequent higher average state of maintenance. Labor costs of maintenance jobs will be considerably reduced, because of the increased efficiency of men satisfied on account of having steady employment. The systematic assigning of work throughout the year will permit an evenly balanced force on sections, as well as the employment of regular extra gangs that can specialize on particular tasks until completed, while section gangs can take care of the smaller jobs scattered over the section.

Committee: E. C. Buhrer, supervisor, N. Y. C., chairman; J. J. Navin, supervisor, Penna.; L. E. Fleming, roadmaster, A., T. & S. F.; Charles Newberg, roadmaster, C. & N. W.; W. S. Fife, roadmaster, N. Y. C. & St. L.; A. Salinsky, roadmaster, B. R. & P.

The Roadmasters Part in Grade Crossing Protection

By F. W. Hillman
Division Engineer, Chicago & North Western, Chicago

THERE is an impression that the roadmaster's responsibility for highway crossing protection is solely a supervisory one, and, so long as he cares for the man power his duty is fulfilled. This is wrong. The roadmaster's duties are fundamentally connected with the physical properties of a railroad and he is responsible for the care and protection of a very large portion of it. He is responsible for the maintenance of fences, gates and cattle guards to protect and control the crossing of cattle over the right-of-way. He is also responsible for the proper physical condition of the highway crossings. He surely then, should have some responsibility for the control and protection of human beings passing over them and have a sound knowledge of the crossing protection problem in general. A general resume of this problem does not, therefore, seem amiss.

The density of highway traffic has increased so rapidly that we now have a rate of travel on highways of from 1000 automobiles per hour up to 4000 or more per hour. It is estimated that in 1924 there will be 15,000,000 licensed automobiles in the United States. Then, there has been a change in the attitude of the people traveling upon highways and some have a peculiar notion as to who has the right to the area jointly occupied by highway and railroad. This in spite of the fact that the courts are more and more insisting that people traveling shall exercise reasonable care in approaching a railroad crossing. The question of convenience arises. Who is most benefited by crossing protection? Particularly is this brought to mind when one sees a long stream of automobiles stopped by a passing train. At once some will say, eliminate the grade crossing; see what the railroads will save in damage claims and expense of crossing protection.

It is authoritatively stated that in the year 1922, 706 grade crossings were eliminated at an approximate cost of $70,000,000, but 4000 new ones were established in the same period. The Interstate Commerce Commission reported that at the close of 1923 there were 252,362 highway grade crossings of railroads in the United States. It has been carefully estimated that the cost of eliminating these would be $15,142,000,000. Assuming that the railways would be required to pay 50 per cent of this cost (some states assess railways a greater percentage) they would have to pay $7,571,000,000, to separate the grade crossings in this country or an amount equal to almost one-third of the valuation of all of the railroads at the end of 1923. It has been estimated that in the state of Wisconsin alone, an amount equal to the total value of the railways in that state would have to be spent in order to eliminate all the grade crossings.

Elimination of grade crossings will result in savings to the railroads by reduction of damage claims and cost of protection, but, except in a few cases, this saving will be about one per cent of the cost.

It is very evident that the grade crossing will be with us for a long time and we will continue to have the crossing protection problem with us. How shall it then be decided as to whether or not a crossing shall have protection? I doubt very much if any general rule can be formulated. Each case must be decided by itself. However, there are three elements which must be considered in all cases; the traffic on the highway; the traffic on the railway and vision of tracks from the highway.

Too often snap judgment is made and crossing protection put on after only a casual survey and once on, it is difficult to remove. An analysis of the crossing should be made first. This should be made from a traffic count and a vision survey. The traffic count should show by hourly periods the traffic on the highway, indicating the number of pedestrians, bicycles, teams and automobiles, also the railway traffic, classifying it as to direction and as to through and switch movements. Such a count should be for more than one day. One satisfactory method is to get a count for one 24 hours period, pick out the eight hours most heavily traveled and then take the count for that period for two more days. A Saturday and Sunday should be included in the count and the other on a mid-week day. Possibly three 24-hour periods should be counted but this is expensive, as it envolves punitive time for men counting and seems justified only in extreme cases. Judgment must exercised in making this traffic count.

The vision survey should show the distance from the highway that trains can be seen from different points on the highway, going out far enough from track to give a fair description. Possibly 300 or 400 ft. is enough. Obstructions to view, grade and alinement of highway,

alinement of tracks and all warning signs should be shown.

From the traffic count it may be shown that protection for only a portion of the day is needed or only on certain days in the week. The vision survey may indicate that some obstruction to view can be removed, such as the trimming or cutting down of trees, or the widening out of banks when the highway is in a cut, or the improvement of the approach of the highway when crossing tracks on a fill. Possibly a slight change in location of the highway can be made or the alignment can be improved. Consideration should be given to the scheme suggested by the A. R. A. which contemplates dividing the highway into two avenues across railroad right-of-way and erecting the "Look Out for Cars" sign in the center with a short fence striped black and white or a mound of rocks at its base extending between the avenues and perpendicular to highway. This has been adopted in some cases and has proved satisfactory. At other places it is objected to as being an obstruction in the highway. Thought should be given to the location and kind of advance warning signs. Those being usually placed outside of railway property possibly should be erected by highway authorities. At any rate they should be consulted and their co-operation solicited. Striping of concrete highways black and white at a few places some distance from tracks appears to be very effective. These studies of the vision survey may obviate the installation of automatic or manual protection and consequent expense.

If, after a study of the traffic and vision survey other protection than properly caring for physical condition is determined as being necessary, what kind of protection shall it be? Protection can be divided into two general classes; automatic and manual. Which of these types is proper is difficult to determine. There are a number of experts at work on this subject. The automatic signal includes the wig-wag, the bell, different forms of barriers raised and lowered across the highway and the flashing light. Moving signals are often disregarded and a demand made for some manual protection. Under manual protection are included any form where the human being is involved, such as a flagman on the ground with a whistle and stop signal, crossing gates, wig-wags and bells operated by men or any combination of these. There are places where these types are preferable to automatic signals, such as at crossings in heavy switching districts, where the automatic signal may give false indications.

One advantage of the automatic signal is that it is continuous protection. It would seem that such a signal should be sufficient in non-switching districts, removing the bell near residential sections. The American Railway Association has approved the recommendation made by its signal section that an electric flash signal be made standard. In cities where there are children to contend with and numerous switching movements, it may be advisable to use gates or flagmen. Many municipalities have demanded one of these forms and some both. The problem is intricate and no rule can be devised, at least not until there is a more thorough co-operation between state and municipal authorities and the railroads. Some municipalities have declared railroad tracks arterial highways and passed an ordinance requiring all vehicles to stop before crossing tracks. Some states have designated certain highways as extra hazardous and require vehicles to stop before crossing tracks. In both cases, however, public opinion does as yet not seem to be in accord with the idea and enforcement of the law is very difficult. The idea of giving gatemen or flagmen police power is often advanced and sometimes done. However, many cities object to delegating police-power to any not directly under their supervision. Then too, it is doubtful if the average gateman or flagman would properly use such power.

Having men in connection with crossing protection, their supervision is important. The question has been raised as to who should supervise these men. It seems best to have the roadmaster do this, giving him an assistant to look after such work where there are a large number of men to supervise. The section foreman should also have supervision, acting, of course, under the roadmaster or assistant. This for the reason that these officers are more familiar with the handling of the type of men usually obtained for flagmen. Also because it is frequently necessary to place a man in a vacancy quickly and a section man can be used temporarily. The type of man hired and his physical condition should be carefully considered. The Chicago & North Western requires all such men to be examined on rules and to undergo a physical examination. Those with imperfect vision or badly crippled are not employed. Men with the best appearance should be placed on important crossings.

Flagmen and gatemen should be instructed as to action in case of emergencies, such as autos stalling on track, or when gates get out of order. In the latter case gateman should assume flagman's duties, removing signals from gates. He should notify foreman as quickly as possible so that repairs can be made. This brings up question as to whether repairman should be called regardless of hours. It does not seem necessary to incur punitive overtime for such work. If the gateman operates gates protecting more than one crossing, a section man or reserve flagman can be called to care for the crossing where gates are damaged. Gatemen should report cause of damage, and, if by vehicle, should, if possible, obtain identification of the same so that damages can be collected.

There is some contention that it is not natural for a man to stay awake during the early morning hours when not actively employed. This results in some railroads permitting gates to be lowered, and raised only when vehicles want to cross, expecting they will wake up gateman if he is asleep. This practice is of very questionable value.

There is no question as to whether a flagman or gateman should give proceed signals to highway traffic. His principal function is to stop it. If proceed signals are given, traffic is likely to forget to take the precautions of looking and listening. Some roads forbid flagmen to give these signals.

Close co-operation with municipal authorities is very beneficial. Their complaints should be attended to, discussed with them, and not relegated to the waste basket. Even though they may seem trivial, if noticed, an antagonistic feeling is avoided. Very few municipal authorities have any conception of the amount of protection they are given.

There are many angles to the crossing protection problem. One eminent engineering authority has stated that the problem is no longer "The Elimination of Grade Crossings," but has become "The Regulation for Grade Crossings." Very much good work is being done along these lines by committees of railroad and state officers, working to formulate rules and standards. They have determined that such rules must be elastic in order to fit peculiar conditions. They found that, in some cases, old laws have to be annulled. Along with this work must go the education of the public as to its responsibility. The pupils are legion and the job will be tedious, although many indications are that it will not be fruitless. In the meantime, patience must be exercised by the railroads, close and intelligent study of the problem continued, and close co-operation had with the municipal and other authorities in an effort to work out the solution.

Other Business and Features of the Meeting

THE COMMITTEE on Subjects suggested the following topics for consideration during the ensuing year:

Programming of Section Work.
How to Inspect and Identify Ties for Renewal.
Means of Prolonging the Service Life of Rail.
Methods and Costs of Weeding Track.
The Roadmaster's Responsibility for the Promotion of Proper Relations With the Public.

The report of the secretary showed that 72 members had been elected during the year and that the total membership at the end of the year was 1,176. The report of the treasurer showed a cash balance of $1,074.76 in addition to two $500 Liberty bonds.

The Election of Officers

The following officers were elected at the annual business session on Thursday morning: President, W. F. Muff, roadmaster, Atchison, Topeka & Santa Fe, Newton, Kan.; First Vice-President, G. W. Morrow, supervisor, New York, New Haven & Hartford, New Haven, Conn.; Second Vice-President, J. B. Kelley, assistant general roadmaster, Minneapolis, St. Paul & Sault Ste. Marie, Minneapolis, Minn.; Secretary, T. F. Donahoe, general supervisor of road, Baltimore & Ohio, Pittsburgh, Pa.; Treasurer, James Sweeney, supervisor, Chicago & Eastern Illinois, Danville, Ill.; members of the executive committee for four years: H. R. Clarke, district engineer maintenance of way, Chicago, Burlington & Quincy, Lincoln, Nebr.; and P. J. McAndrews, roadmaster, Chicago & North Western, Sterling, Ill.

Kansas City, Mo., was selected as the location for the next convention.

Inspection Trips and Annual Dinner

Following the adjournment of the convention on Tuesday afternoon, the members were taken for a trip to Atlantic Highlands at Sandy Hook, N. J., and returned on one of the passenger boats of the Central of New Jersey and thus given an opportunity to inspect much of New York's waterfront. The annual dinner of the Track Supply Association was given on Wednesday at the Hotel Commodore, with about 600 people present.

Following the adjournment of the convention on Thursday noon, the members were given an opportunity to inspect some of the track and facilities of the New York, New Haven & Hartford. A special train provided by that road took the party from the Grand Central Terminal in New York City to the Van Nest shops of the New Haven near New Rochelle and the float bridges at Hunts Point, thence returning to the city over the Hell Gate bridge of the New York Connecting Railroad, through the Sunnyside yards of the Pennsylvania into the Pennsylvania Terminal. Stops were made at the Van Nest shops, at Hunts Point and on the bridge.

The Track Supply Exhibit

THE exhibit of the Track Supply Association was held in the main ballroom adjoining the convention hall. The booths were well and attractively arranged with a total of 60 companies exhibiting. The officers for the past year were: President, J. J. Cozzens (Union Switch & Signal Company, New York City); First Vice-President, A. H. Told (Positive Rail Anchor Company, Marion, Ind.); Secretary-Treasurer, W. C. Kidd (Ramapo-Ajax Corporation, Hillburn, N. Y.); Directors, Alex Chapman (Rail Joint Company, Chicago); K. J. Eklund, vice-president, Mudge & Company, Chicago); and J. H. Horn (sales manager, National Lock Washer Company, Newark, N. J.); Advisory Directors, E. T. Howson (editor, *Railway Engineering and Maintenance*, Chicago); and R. A. Van Houten (vice-president, Sellers Manufacturing Company, Chicago); Ex-Officio Director, Honorary Director, J. B. Martin (president, Roadmasters' and Maintenance of Way Association, Cleveland, Ohio).

List of Exhibitors

Air Reduction Sales Company, New York; oxygen, acetylene and carbide cutting and welding apparatus and regulators; E. Van Alstyne, C. A. Daly, E. W. Irwin, H. A. Hocking and R. F. Helmkamp.

American Chain Company, Bridgeport, Conn.; guard rail clamps, replacers, rail benders, one-piece guard rail, compromise joints; J. J. O'Connell and A. H. Weston.

American Cast Iron Pipe Company, New York; water pipe and couplings; E. W. Hermann and W. J. Lyman.

American Hoist & Derrick Company, St. Paul, Minn., illustrations and photographs of ditchers; Miss H. Hoeller, W. L. Manson, A. W. Dodge and H. W. Davis.

American Valve & Meter Company, Cincinnati, Ohio; interlocking and gearless switch stands and safety locking device; J. T. McGarry, Cecil Stevens and D. J. Higgins.

Balkwill Manganese Crossing Company, Cleveland, Ohio; model of an articulated cast manganese steel crossing; S. Balkwill and S. W. Balkwill.

Bethlehem Steel Company, Bethlehem, Pa.; switch stands, guard rail, lock nuts, gage rods and warning signs; Neil E. Salsich, E. H. Gumbart, R. Knibloe, J. W. Stoever, G. S. Vickery, R. L. Gillespie, R. Deghuee, C. A. Alden and J. V. Honeycutt.

Brown Rail Loader Company, Boston, Mass.; model of rail loader, moving pictures; J. C. Barr and W. B. Joyce.

Buda Company, Chicago; section motor car, switch stand, tool grinder, motor car wheels, track drill, track jack; J. E. Murray, H. C. Beebe, H. C. Clawson and C. W. Wood.

Carbic Manufacturing Company, Duluth, Minn., carbic light, acetylene welding and cutting apparatus and carbic cakes; Gordon Paterson and C. H. Bolinder.

Chicago Malleable Castings Company, Chicago; rail anchor tie plates and photographs of bumping posts; Warren Osborn.

Chipman Chemical Engineering Company, Inc., New York City; B. G. Thompson and T. B. Bowman.

Cleveland Railway Supply Company, Cleveland, Ohio; flangeway guard, foot guard, guard rails, switches, switch stand, rail anchor, photographs of locomotive crane; F. A. Peck, W. H. Neeson, D. P. Blum and P. L. Millikin.

Creepcheck Company, Inc., Hoboken, N. J.; creepchecks; A. J. Dinklage, P. E. Brown, F. J. Reagan, T. J. Farrell and T. D. Crowley.

Crerar Adams Company, Chicago; hand and power bonding drills, track drill, rail saw, die starter, jacks, track liners and handles; Russell Wallace and W. I. Clock.

Duff Manufacturing Company, Pittsburgh, Pa.; track, journal and bridge jacks; C. A. Methfessel and E. A. Johnson.

Elliot Frog & Switch Company, East St. Louis, Ill., adjustable switch brace, guard rail clamp, adjustable clips; H. J. Elliott and T. K. Drummond.

Fairbanks, Morse & Co., Chicago; inspection car and wheels; F. M. Condit, R. F. Lane, H. L. Hileary, J. L. Jones, E. E. Pendray, E. P. Chase, H. E. Vogel and P. H. Gilleland.

Fairmont Railways Motors, Inc., Fairmont, Minn.; section car and light inspection car; H. E. Wade, W. E. Kasper, W. D. Brooks and E. R. Mason.

Frictionless Rail, Boston, Mass.; rail; D. W. Simonds and J. W. McManama.

J. R. Fleming & Son Company, Scranton, Pa.; switch point protector; J. R. Fleming, A. J. Fleming and J. A. Moffatt.

Hauck Manufacturing Company, Brooklyn, N. Y.; thawing outfits, kerosene torches, circular flame burners, venturi burners; W. C. Elze and G. N. Broadhurst.

Hayes Track Appliance Company, Richmond, Ind.; derail and model, and portable blue flag derail; S. W. Hayes, H. J. Mayer and H. Q. Hamilton.

Headley Good Roads Company, Philadelphia, Pa.; photographs of crossings; W. T. Gilbert and E. J. Hunt.

Hubbard & Company, Pittsburgh, Pa., shovels, track tools and nut locks; J. S. Wincrantz and Steward Remmel.

Idol Track Liner Co., Chicago; track liners, track jacks, tie plates, rail pusher; T. D. Crowley and F. Hackman.

Ingersoll-Rand Company, New York; pneumatic tie tamper, pneumatic rail drill, pneumatic nutting machine, pneumatic shovel and pneumatic bonding drill; W. H. Armstrong, E. F. Kultchar and G. E. Bridge.

Ingot Iron Railway Products Co., Chicago; models of corrugated metal culverts and photographs; E. F. Moore, L. M. Sandston, T. W. Jenkins and P. M. Reinartz.

O. F. Jordan Company, East Chicago, Ind.; moving pictues, A. L. Greenabaum, J. C. Forbes and A. W. Banton.

Kalamazoo Railway Supply Company, Kalamazoo, Mich.; motor car, combination track gage and level; F. F. McAllister, E. M. McNally and K. I. Clisby.

Kentucky Rock Asphalt Company, Louisville, Ky.; rock asphalt, models of crossings; W. F. Pollard.

Lundie Engineering Corporation, New York; tie plates, rail anchors; Dr. John Lundie, W. Brooke Moore, L. B. Armstrong and E. Brandeis.

Maintenance Equipment Company, Chicago; friction car stop, steel fence post, blue flag derail, moving pictures of rail layer and power ballast screen, switch point straightener, tie spacer and combination tie plate; J. A. Roche.

Metal and Thermit Welding Corporation, New York; welding compounds and welded materials; W. R. Hulbert and R. W. Swan.

Mudge & Company, Chicago; motor car; Karl J. Eklund.

National Lock Washer Company, Newark, N. J.; spring washers, lock washers and testing machine; J. Howard Horn, F. B. Archibald, W. R. Hillary and F. J. Gerhard.

Northwestern Motor Company, Eau Claire, Wis.; photographs of motor cars; F. W. Anderson.

Oxweld Railroad Service Company, Chicago; F. C. Hasse, W. H. Kofmehl, L. C. Ryan, Fred Lurquin, C. A. Bloom, F. G. Duffie and W. E. Campbell.

P. & M. Company, Chicago; anti-creepers and bond wire protectors; D. T. Hallberg, L. S. Walker and T. J. Byrne.

Pocket List of Railroad Officials, New York copies of publication; Harold A. Brown.

Positive Rail Anchor Company, Marion, Ind.; girder type guard rail, rail anchors, rail braces, guard rail plates and braces and tie plates; A. H. Told and L. C. Ferguson.

Q & C Company, New York; guard rail clamp, compromise joint, derails; F. F. Kister, L. T. Burwell, E. M. Smith, H. T. Henry and R. B. Quincy.

Rail Joint Company, New York; insulated joints, compromise joints, standard joints, track liner and motion pictures; Charles Jenkinson, R. W. Payne, Alex Chapman, G. T. Willard, C. B. Griffin, W. E. Gadd, Milton Markley, E. A. Condit, V. C. Armstrong, C. A. Disbrow and R. R. Seward.

Railroad Supply Company, Chicago; tie plates; H. M. Buck, A. H. Smith and G. F. Hall.

Railway Engineering and Maintenance, Chicago, copies of *Railway Engineering and Maintenance*, Railway Age, Railway Electrical Engineer, Railway Signaling, Railway Mechanical Engineer, Maintenance of Way Cyclopedia, Roadway and Track, Simplified Curve and Switchwork; E. T. Howson, Milburn Moore, J. M. Rutherford, F. C. Koch, H. E. McCandless.

Railway Review, Chicago; copies of publication; C. L. Bates, Elmer Geugeon, G. E. Boyd.

Ramapo-Ajax Corporation, Hillburn, N. Y.; automatic switch stand, double shoulder switch plate, manganese guard rail, guard rail clamp, forged braces; J. B. Strong, W. C. Kidd, R. J. Davidson, Jr., D. F. Hilton, T. E. Akers, John V. Houston and J. E. Davidson.

Rapid Drainage Pipe Corporation, New York; porous concrete pipe; A. Schmidt.

Reade Manufacturing Company, Jersey City, N. J.; model of chemical weed killing machine, C. H. Reade, L. J. Reade, F. E. Norris, G. W. Josten, E. E. Prarie and F. L. McAndrews.

Reliance Manufacturing Company, Massillon, Ohio; nut locks; H. J. McGinn, E. W. Hart, E. D. Colwin and R. L. Shireman.

Safety Appliance Sales Company, Chattanooga, Tenn.

Sellers Manufacturing Company, Chicago; wrought iron tie plates; G. M. Hogan, R. A. Van Houton and R. J. Platt.

Templeton, Kenly & Co., Ltd., Chicago; track jacks, bridge jacks and emergency jacks; G. L. Mayer.

Track Specialties Company, Inc., New York; guard rail clamps, step joints, spikes, tie check-checkers and dating nails; W. B. Lee and J. A. Bodkin.

Union Switch & Signal Company, Swissvale Pa.; insulated rail joints; J. J. Cozzens.

Verona Tool Works, Pittsburgh, Pa.; track tools, nut locks; track jacks, rail joint springs, track liners and circuit bonds; W. F. Hart, W. C. Dawkins, P. L. Laughlin and W. W. Glosser.

Warren Tool & Forge Company, Warren, Ohio; adzes, claw-bars, lining bars, picks, spike mawls, sledges, hammers, track chisels, wrenches; H. C. Mull, M. J. Konold and J. D. Roberston.

Western Wheeled Scraper Co., Aurora, Ill.; model of automatic side dump car and photographs; H. P. Henderson and Thomas Dugan.

William Wharton, Jr., & Co., Inc., Easton, Pa.; insulated gage rod, conveyor rollers, photographs of manganese frog, gas cylinders; W. H. Allen and J. A. Millholland.

Woolery Machine Company, Minneapolis, Minn.; motor car engines and parts; J. T. Stephenson.

Wyoming Shovel Works, Wyoming, Pa.; track shovels, spades, scoops, scuffle hoes and picks; H. T. Potter, Stanley H. Smith and E. L. Ruby.

Non-Exhibiting Members

American Steel & Wire Company, Chicago.
James C. Barr, Boston, Mass.
Cleveland Frog & Crossing Company, Cleveland, Ohio.
Mechanical Manufacturing Company, Chicago.
Morden Frog & Crossing Works, Chicago.
National Malleable & Steel Castings Company, Cleveland, Ohio.
Pettibone-Mulliken Company, Chicago.
Railway Purchases and Stores, Chicago.
St. Louis Frog & Switch Company, St. Louis, Mo.

At the annual meeting of the Track Supply Association the following officers were elected for the ensuing year: President, K. J. Eklund, Mudge & Co., Chicago; vice-president, L. C. Ryan, Oxweld Railroad Service Company, N. Y.; secretary-treasurer, W. C. Kidd, Ramapo-Ajax Corporation, Hillburn, N. Y.; and directors, F. M. McAllister, Kalamazoo Railway Supply Company, Kalamazoo, Mich., and W. W. Glosser, Verona Tool Works, New York.

Cross Tie Purchases in 1923

A TOTAL of 135,976,117 crossties was purchased by steam and electric railway companies in 1923, according to data collected by the Bureau of the Census, in co-operation with the Forest Service of the Department of Agriculture, and issued by the Department of Commerce. As compared with this, the crosstie purchases totaled 123,766,000 (estimated) in 1915 and 135,053,000 in 1911. The number of poles purchased in 1923 by steam and electric railroads, electric light and power companies and commercial telegraph and telephone companies, was reported as 3,060,794, as compared with 4,077,964 poles in 1915 and 3,418,020 poles in 1911.

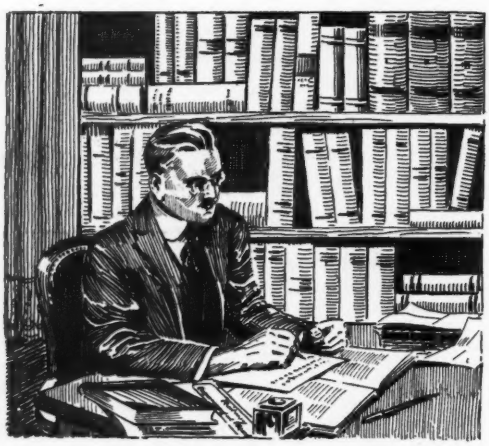
The number of crossties of various kinds purchased for five specified years are shown in the following table, the figures for 1923 being preliminary in character and subject to such corrections as may be found necessary upon further examination of the returns.

CROSSTIES PURCHASED, BY KINDS OF WOOD

Kind of Wood	1923	*1915	1911	1909	1907
Oak	62,915,237	49,333,881	59,508,000	57,132,000	61,757,000
Southern pine	22,048,967	14,115,681	24,265,000	21,385,000	34,215,000
Douglas fir	15,316,571	6,950,910	11,253,000	9,067,000	14,525,000
Cypress	5,243,835	4,478,612	5,857,000	4,589,000	6,780,000
Chestnut	4,419,782	4,548,352	7,542,000	6,629,000	7,851,000
Tamarack or larch	4,220,194	3,858,098	4,138,000	3,311,000	4,562,000
Cedar	3,676,228	5,122,103	8,015,000	6,777,000	8,954,000
Hemlock	3,477,740	859,662	3,686,000	2,642,000	2,367,000
Gum	3,050,798	485,466	1,293,000	378,000	15,000
Maple	3,035,007	1,069,547	1,189,000	158,000	.....
Redwood	2,492,445	563,685	1,820,000	2,088,000	2,032,000
Beech	2,279,221	1,173,490	1,109,000	195,000	52,000
Western yellow pine	1,340,007	1,402,836	2,696,000	6,797,000	5,019,000
Lodgepole pine	949,451	1,316,819	.....	.....	.....
Birch	369,154	465,815	.....	.....	.....
All other	1,141,480	1,361,694	2,682,000	2,603,000	5,574,000
Total	135,976,117	§97,106,651	135,053,000	123,751,000	153,703,000

*Compiled by Department of Agriculture, Forest Service. Mileage of railroads reporting represented 78.46 per cent of total.
§Estimated total for all railroads, 123,766,000 (see note *).

What's the Answer?



This department is intended to help our readers secure answers to the questions which arise in their work in the maintenance of tracks, bridges, buildings and water service. An endeavor will be made to answer promptly by mail, any questions received. Such questions as are of general interest will also be submitted in these columns for further discussion. *Railway Engineering and Maintenance* solicits the co-operation of its readers in answering the questions which are published.

Questions to be Answered in the December Issue

1. Does the frequency of rail breaking at insulated joints justify their removal for inspection on the approach of winter?

2. To what extent is it practical to precut at a central point the lumber required for small standard railway buildings?

3. Does the likelihood of sudden thaws during the winter warrant opening track ditches whenever snow is plowed from the track?

4. Under what conditions can electricity be used to thaw out water lines? How is it done?

5. What is the maximum permissible variation from the standard spacing of joints and centers on tangent track? On curves?

6. To what extent is it advisable to purchase supplies for boarding camps and outfit cars locally?

7. What plan should be followed for keeping spikes snug to the rail at all times?

8. What measures can be taken to overcome dustiness and glare of concrete floors?

Uniform Track Forces

To what extent is a northern road warranted in maintaining uniform track forces throughout the year? What constructive and necessary work can be done efficiently during the winter?

First Answer

The maintaining of uniform track forces throughout the year is a condition which all maintenance officers would welcome if weather conditions would permit. The track equation method of allocating track forces, in use on the Delaware, Lackawanna & Western, provides for uniform forces during the summer and winter seasons, which cover the periods April 1 to November 1 and November 1 to April 1, respectively. But it is my belief that it is not economical to maintain uniform track forces throughout the year on the Delaware, Lackawanna & Western.

The large percentage of the track work must be done in the summer season. Frost in the ground, snow and ice prevent any maintenance work being performed in the winter season which requires the moving of the track. Rail laying, tightening of bolts and spiking can be done during the winter season. The amount of rail depends entirely upon weather conditions. Therefore, it is essential that sufficient forces are allowed section foremen, in order that all of the work of raising, tieing, ballasting and lining of track can be completed during the summer season.

A. J. NEAFIE,
Principal Assistant Engineer, Delaware, Lackawanna & Western, Hoboken, N. J.

Second Answer

In my judgment, uniform track forces are not in any sense justified. A policy of this kind would be ruinous financially. Track forces must of necessity be provided to meet the requirements of seasonal work. The bulk of track maintenance work on northern roads must be accomplished during the months of April to October, inclusive. On the Chicago & North Western we have to install between 3,000,000 and 4,000,000 ties per year and tie installation can only be handled economically during the fore part of the working season. Other large items of maintenance expense are the cutting of weeds, general maintenance of roadbed and surfacing and lining of track. To do the work economically, a considerable portion of the weeds are taken care of in connection with the installation and surfacing during the months of June, July and August. It goes without saying that there is no necessity for employing a large force of men to cut weeds during the winter months, and further, the work indicated above can only be handled during the so-called working season.

In the northern territory there is practically no constructive and necessary work that could be handled efficiently during the winter months. It is, of course, necessary to maintain a small force to take care of track inspection and keep switches and tracks free from snow and ice and such forces are utilized to tighten bolts and do certain other work of a similar character. Where it is possible to relay rail during the winter months, our experience is that this cannot be done efficiently and should not be undertaken during the winter unless other

conditions require. During a considerable portion of the average winter, in the northern territory, it is impossible for men to accomplish any work other than inspection, or keeping the tracks free from snow and ice. On a number of our northern divisions it is safe to say that 75 per cent of the time of the men employed during extreme winter weather conditions is devoted to removing snow and in work of like character. Obviously, with the track buried under from one to several feet of snow during what we term a bad winter, no constructive work on roadway and track could be accomplished.

About a year ago a series of articles were published in *Railway Engineering and Maintenance* in a prize contest, with reference to the manner in which maintenance forces could aid best in handling the large volume of traffic, etc., and these articles, as far as they apply to northern roads, indicate, I believe, the necessity for seasonal work and the handling of the bulk of the maintenance work during the months of April to August, inclusive, in order that tracks and facilities might be in shape for handling the heavy volume of business during the fall months without undue interruption to traffic.

C. T. DIKE,
Engineer of Maintenance, Chicago & North Western, Chicago.

Helpers In B. & B. Gangs

What is the most efficient ratio of helpers to carpenters in bridge and building gangs?

First Answer

The number of carpenters to carpenter helpers in a bridge gang depends largely on the character of the work. On some of the larger roads where the carpenter gangs have extensive wooden structures to replace, such as Howe trusses, large wooden trestles, the number of carpenters should be 70 per cent and helpers about 30 per cent. Most of the carpenter repair gangs have work of a varied kind, such as installing pipe culverts, miscellaneous timber repairs, small concrete jobs, in fact, general maintenance of railroad structures. The carpenters and helpers do practically the same work and under these conditions the number of helpers should be equal to the number of carpenters.

In masonry gangs with a large amount of form work, the number of carpenters should be about 70 per cent and helpers 30 per cent. The turnover of labor in the last 20 years has been so great that the average bridge carpenter of today is but slightly more efficient than the average carpenter helper. The only real bridge carpenters are those men who have remained in service for a considerable term of years. J. S. HUNTOON,
Assistant Bridge Engineer, Michigan Central, Detroit, Mich.

Preparing for Winter Track Work

What preparations should a yard track gang make for winter?

First Answer

The first and most important work for yard gangs in preparation for winter is to see that all switches are thoroughly drained. This will greatly facilitate the work when the snow comes and make it easier to keep the switches in operation.

All the area around water columns should also be drained to prevent ice from forming and causing a dangerous condition for trainmen operating in the yard. Guard rails should be inspected as also should all frogs, and any loose or broken bolts should be tightened or renewed. The heels of switches, the guard rails, and frog wings should be fitted with guards to prevent trainmen and others getting their feet caught. Some manufacturers fasten these foot guards directly to the frogs and guard rails, but where this is not done blocks of wood should be fitted for the purpose.

The tool stock should be gone over carefully and precautions taken to see that plenty of snow brooms and shovels are on hand. Where hydro carbon or other snow melting oil is used, the tanks and cans should be inspected and all defective cans repaired and the tanks filled.

The yard should be policed and all drawheads, brake beams, etc., cleaned up and removed from the running tracks. If possible, a work train should pick up all this material and either take it to the scrap dock, or in the case of material that can be used again, place it where the department interested can make use of it.

Rail, switch and frog renewals can be carried on during the winter and it is good policy to check up on this work and get requisitions in for badly needed renewals. Rail that is badly rolled out can be rolled back into position by adzing the ties, and if tie plates can be secured the same can be applied during the winter months. Preparations should be made for this work by getting the tie plates ordered and on the ground.

Winter track work in yards does not differ so very much from that carried on during the balance of the year, except, of course, with respect to tie and switch timber renewals and tamping and lining track, and if a yard is kept in good condition throughout the rest of the year, there really will be no need for extra preparations for winter. R. L. HARING,
Supervisor of Track, Long Island, Jamaica, N. Y.

Second Answer

In yards where heavy switching is continually performed, the wear and tear on track facilities is great and in order that such tracks may withstand the movement of heavy power and equipment during the winter months it is essential that they be placed in the best possible condition. This work should be done during the summer or early fall, thereby relieving the track forces of much maintenance work during the winter when their services are needed for work peculiar to that season of the year, especially in the territory north of the Mason and Dixon line.

It has been my experience that a very effective plan to follow in overhauling yard tracks, is to take one track at a time, make the necessary renewals such as rails, ties, tie plates, angle bars, etc., and surface the track throughout, taking special care to see that the space between tracks is properly graded to prevent possible injury to trainmen. A special effort should also be made to provide adequate surface drainage, thereby avoiding the collection of water and ice on and between tracks and especially in the vicinity of frogs and switches. When the first track has been thoroughly overhauled, the force is transferred to the second track and the work carried on in a similar manner until the entire yard has been overhauled. no track or any portion of a track having been overlooked or neglected.

However, in order to follow out the above plan successfully, it is necessary to obtain the co-operation of the operating department since better results are obtained by discontinuing the use of tracks where this work is being done. The track forces can then place the track in a much better condition in less time and at less expense than could have been done under traffic. It has been my

experience that after the advantages and benefits of the above plan have been explained to the operating officer in charge of the yard, no opposition will be met from that source.

The tracks having been placed in a first class condition during the summer months and early fall, the necessary preparation should be made and tools and supplies obtained for carrying on the regular winter work. A check should be made and orders placed to see that a sufficient quantity of salt, the proper number of shovels, picks, snow brooms, etc., are available for the first snow storm.

If the above plan is carried out in large yards, where so much trouble is encountered during winter months, it is my judgment that the track forces will be called out for emergency repairs and derailments less often than in the past, thereby affording them more time for their regular winter work, such as keeping the tracks and switches free from snow and ice. J. J. DESMOND,
Roadmaster, Illinois Central, Chicago.

Constructing Industry Tracks

Should railways encourage industries to contract the construction and maintenance of their tracks or can this be done to better advantage by railway forces?

First Answer

As a general proposition, it is better to have the railway forces construct and maintain industrial sidings, for the railway forces generally comprise experienced men who can perform the work in a better manner and cheaper than if done by outside parties.

In the construction of a long industrial track or a small yard, if the railway forces are reduced by existing conditions, it frequently will pay to have the work performed by labor provided by the industrial company working under the direction of a competent track man whose salary for the time will be paid by the industry.

The same rule generally holds true as regards the maintenance of private tracks. If the trackage is on a large scale, usually the industry has its own force of men, or at least it has available certain men who have an elementary knowledge of track work from performing such duties at frequent intervals throughout the year although not specially assigned to that class of work. When extraordinary repairs, however, are contemplated and no experienced plant force is available, it is the general practice of the Reading to have plant men, assisted by experienced track men, perform the work, all working under the direction of a competent foreman provided by the railway.

After all, is not this question one to be decided by the local conditions and the men available from the railway forces? While it is probably a fact that the work can be done in a better manner by experienced track men, it may, on the other hand, be to better advantage to both parties to have the work performed by the industrial plant men under the supervision of an experienced track man in order to get the work rushed through promptly.

J. C. WRENSHALL,
Engineer Maintenance of Way, Reading, Reading, Pa.

Second Answer

Inasmuch as the railroad is organized to produce transportation and that among the requisites for this production and its marketing are knowledge and skill in the construction and maintenance of tracks, it would seem that there is every good reason why the railroad should be willing and indeed anxious to extend its capabilities in these matters to its customers to the full extent that this may be practicable. It is true that the railroad often is unable to spare its facilities for track work to an indusry, but the advantages to both parties are so important when this can be done that to adopt a counter course as a matter of policy appears unwise. The aim of the railroad should be, as it is, that its service shall be as complete and frictionless as possible and it appears to the writer that opportunities to that end are to be had in exercising an interest in its customers' facilities, for the prompt and effective handling of cars.

Relatively, the demands of maintenance are more easily met than the demands of construction, and this circumstance, together with the fact that the proper conditioning of existing tracks bears a far more important relation to the handling of current business than does the ordinary construction job, warrants the railroad in extending its facilities for maintenance to the industry even though it may feel that it is unable to do likewise in matters of construction. E. D. SWIFT,
Engineer Maintenance of Way, Belt Railway of Chicago, Chicago.

The Radiation For Frame Buildings

How can one determine the amount of radiation required for heating an ordinary frame building with hot water? With steam?

The problem of determining the amount of radiation required for heating buildings is a complicated one where resort must be had to the fundamental principles of radiation because of the many factors which must be taken into consideration. Among these factors is that of determining the amount of heat produced by the plant, which involves a knowledge of the boiler temperatures and pressures, together with transmission losses, while other factors have to do with the rate at which the heat is consumed. Obviously this depends upon such factors as the size of the rooms, kind of material with which they are constructed, the quality of the construction, the arrangement of the rooms, the amount of window space, the temperatures outside of the building, its position, the duration of heating desired, the style of heating desired, etc. Fortunately, however, the frequency with which determinations of this kind have been required and the experience had with actual installations has resulted in the development of various rules and tables which greatly simplify the problem. The accompanying table affords one commonly used basis for problems of this character both for steam radiation and for hot water heating. This table requires the preliminary determination of the square feet of glass area in each room, the square feet of exposed wall and the cubical contents of the room, whereupon the number of square feet of radiation can be determined directly from the table.

This table has been computed on the basis of 180 deg. F. of temperature at the boiler for water heating and on the basis of two pounds pressure at the boiler for steam heating and provides sufficient radiation to allow one change of air per hour with an inside temperature of 70 deg. F. and an outside temperature of zero at sea level and with an allowance for prevailing winds of 12½ miles per hour. Sufficient radiation is also provided to take care of the average dwelling types of building where the heat is allowed to go down at night or where windows in sleeping rooms are allowed to remain open all night. When using the table, the floors, ceilings or walls over, under and adjoining unheated rooms should be figured as exposed wall. Also, in cases of buildings sub-

jected to extreme exposure the radiation value should be increased 100 per cent where it is of the indirect type, while a 50 per cent increase should be made in the radiation for poor frame construction, 50 per cent for poorly fitted windows and 10 per cent for rooms on the windward side. If the building is to be heated day and night the amount of radiation provided in the table may be reduced 10 per cent, while a 50 per cent reduction in the area of glass may be made where double windows are provided, a 10 per cent reduction in the area of exposed walls, where the walls are made of brick, and a 25 per cent reduction in the radiation for sleeping rooms. Other factors to be considered when using this table are the allowance of a 1½ per cent increase in the amount of radiation required for every 500 ft. above sea level and the following increases for outside temperatures less than zero.

10 per cent for 5 deg. below zero.
20 per cent for 10 deg. below zero.
25 per cent for 15 deg. below zero.
30 per cent for 20 deg. below zero.
35 per cent for 25 deg. below zero.
45 per cent for 30 deg. below zero.
50 per cent for 35 deg. below zero.

TABLE OF ESTIMATED RADIATION

STEAM						WATER					
Sq. ft. glass	Sq. ft. rad. required	Sq. ft. exposed wall	Sq. ft. rad. required	Cu. ft. contents	Sq. ft. rad. required	Sq. ft. glass	Sq. ft. rad. required	Sq. ft. exposed wall	Sq. ft. rad. required	Cu. ft. contents	Sq. ft. rad. required
4	2	10	1	350	3	4	2	10	2	350	4
6	3	20	2	400	3	6	3	20	3	400	4
7	3	30	3	450	3	7	4	30	4	450	5
8	3	40	4	500	4	8	4	40	5	500	5
9	4	50	5	550	4	9	5	50	7	550	6
10	4	60	6	600	4	10	5	60	8	600	6
12	5	70	7	650	5	12	6	70	9	650	7
14	5	80	8	700	5	14	7	80	10	700	7
16	6	90	9	750	5	16	8	90	12	750	8
18	7	100	10	800	6	18	9	100	13	800	8
20	7	110	10	850	6	20	10	110	14	850	9
22	8	120	11	900	6	22	11	120	15	900	9
24	9	130	12	950	7	24	12	130	17	950	10
26	9	140	13	1000	7	26	13	140	18	1000	10
28	10	150	14	1100	8	28	14	150	19	1100	11
30	11	160	15	1200	8	30	15	160	20	1200	12
32	12	170	16	1300	9	32	16	170	22	1300	13
34	12	180	17	1400	10	34	17	180	23	1400	14
36	13	190	18	1500	10	36	18	190	24	1500	15
38	14	200	19	1600	11	38	19	200	25	1600	16
40	14	220	20	1700	12	40	20	220	28	1700	17
42	15	240	22	1800	12	42	21	240	30	1800	18
44	16	260	24	1900	13	44	22	260	33	1900	19
46	16	280	26	2000	14	46	23	280	35	2000	20
48	17	300	28	2100	14	48	24	300	38	2100	21
50	18	320	30	2200	15	50	25	320	40	2200	22
52	18	340	31	2300	16	52	26	340	43	2300	23
54	19	360	33	2400	16	54	27	300	45	2400	24
56	20	380	35	2500	17	56	28	380	48	2500	25
58	20	400	37	2600	18	58	29	400	50	2600	26
60	21	420	39	2700	18	60	30	420	53	2700	27
62	22	440	40	2800	19	62	31	440	55	2800	28
64	23	460	42	2900	20	64	32	460	58	2900	29
66	23	480	44	3000	20	66	33	480	60	3000	30
68	24	500	46	3200	22	68	34	500	63	3200	32
70	25	520	48	3400	23	70	35	520	65	3400	34
72	25	540	50	3600	24	72	36	540	68	3600	36
74	26	560	51	3800	26	74	37	560	70	3800	38
76	27	580	53	4000	27	76	38	580	73	4000	40
78	27	600	55	4200	28	78	39	600	75	4200	42
80	28	620	57	4400	30	80	40	620	78	4400	44
82	29	640	59	4600	31	82	41	640	80	4600	46
84	29	660	60	4800	32	84	42	660	83	4800	48
86	30	680	62	5000	34	86	43	680	85	5000	50
88	31	700	64	5200	35	88	44	700	88	5200	52
90	32	720	66	5400	36	90	45	720	90	5400	54
92	32	740	68	5600	38	92	46	740	93	5600	56
94	33	760	70	5800	39	94	47	760	95	5800	58
96	34	780	71	6000	40	96	48	780	98	6000	60
98	34	800	73	6500	45	98	49	800	100	6500	65
100	35	850	78	7000	48	100	50	850	107	7000	70

Maintaining Insulated Joints

How should the responsibility for the maintenance of insulated joints be divided between track and signal forces?

The rule and custom on the Union Pacific in maintaining insulated joints ordinarily provides that when an insulated joint is to be taken apart, both the section foreman and signal maintainer must be present and participate in the work, except in emergencies when either the section forman or signal maintainer will do the work himself.

Ordinarily the section foreman is responsible for all bolts being kept tight, and the signal maintainer is responsible to see that all fiber insulation material is in proper condition and properly placed. If the section foreman consider that an insulated joint needs ordinary work done on it, he will call on the signal maintainer to be present and take care of his part of the work. In case the signal maintainer considers an insulated joint needs ordinary work done on it he will call in the section foreman to take care of his part of the work.

Tie renewals, tamping, gaging, spiking, bolting, etc., comprise work for which the section foreman is held responsible, and he cannot allow an insulated joint to become a "low joint" or to be otherwise in an unsafe or unsatisfactory riding condition, any more than any other joint, but unless there is some emergency he may not drive up expansion or do any other work affecting the insulating qualities of the joint, unless the signal maintainer is present to take care of the insulating features.

R. B. ROBINSON,
Engineer Maintenance of Way, Union Pacific, Omaha, Neb.

Protecting Wet Paint From Flies

What can be done to keep insects away from fresh paint?

First Answer

Oil of cedar may be used successfully as an ingredient in paints to keep insects away from freshly painted surfaces. This material has a pungent odor that tends to repell insects and when placed in shallow dishes in a closed room will kill moths. It is very similar to spirits of turpentine, but does not evaporate as quickly. As much as one-half pint—event a little more—to a gallon of paint, replacing the spirits of turpentine, will not lessen the durability of the outside paint.

Second Answer

In spite of long experience with insect pests such as gnats, flies and, worst of all, shad flies, I have never been able to meet their onslaught on newly painted work, nor do I think where work is done in the open, there is any preventive.

MARTIN KANE,
Building Superintendent, Delaware & Hudson, Albany, N. Y.

Winter Drains for Water Softeners

What is the best method of sludging out treating plants where the open ditch or tile line is apt to freeze or clog up in winter?

First Answer

The fundamental requirement in sludging out treating plants in winter, of course, is to protect the sludge line from freezing. The open ditch is not practical unless the fall is sufficient to avoid freezing when the softener is sludged. If a tile line is used it should be laid far enough underground to prevent freezing. This line should discharge into a sump or other place of lower level so that water will not stand around the discharge end. Local conditions of course should always be considered in determining the best solution.

W. M. BARR,
Consulting Chemist, Union Pacific, Omaha, Neb.

Second Answer

On our new type of continuous water softening plants, we use a closed tile line which is below the frost line. This line discharges into an open sump which is periodically cleaned out with the clam shell bucket. On our

old intermittent water softening plant the sludge is shovelled out of the settling tank once a month.

It is my opinion that where the tile line is not below the frost line or an open ditch is used, if the sludge is removed by means of quick opening "pump handle" valve which is opened and closed in quick succession, the pressure in the tank will force the sludge far enough away from the plant so that cold weather will not interfere with the operation of sludging. R. E. COUGHLAN,

Supervisor Water Supply, Chicago & North Western, Chicago.

Giving Old Ties Away

To what extent is it practicable to dispose of old ties to residents along the line? What objections, if any, are there to this practice?

In the average year, more than 100,000,000 ties are inserted in tracks and, of course, an equal number of old ties are removed. The general practice is to burn them and it has always been a source of wonder that the practice has not received more attention from those who like to criticize the railroads.

At first glance it does not seem exactly right, neither has it ever seemed just the thing to do by any railroad in the country. As evidence of the fact, let any roadmaster look back to the days when he loaded up all his old ties and shipped them in to be used as engine kindling. There was no particular difficulty in shipping them in, it was the man who had to saw them who had the trouble, with the imbedded gravel and the occasional buried spike. Then came the introduction of the bulldozer which succeeded in breaking the ties up into very good engine kindling, until it was discovered that when labor and transportation costs were included, it was cheaper to burn fuel oil.

But the ties continued to come out of the track and the railroads kept on trying to use them. In the sand country, fences against the drifting sand were made of them. In the southwest the Santa Fe formerly used them to build log cabins for the Mexican laborers. Other uses were found in cribbing or retaining walls. But as compared to the whole supply of such old ties the quantity used by the railroads has been negligible.

Confronted with the disposal of so great an amount of waste material the railroads have often got themselves into difficulties. Teamsters were allowed on the right-of way to haul off the ties and accidents happened. Others came on the right-of-way, supposedly to haul away old ties, and removed new material. The outcome was that railroads generally have discontinued the practiec of allowing any ties to be removed from the right-of-way, except under the supervision of the trackmen, or when the parties are well known, and the practice of giving them away at all is not encouraged except in localities where fuel is so scarce that the privilege of securing the old ties is appreciated.

In those sections of the country, there is often an exchange of values, the farmer granting the privilege of erecting snow fences on his land or plowing fire guards in return for the old ties. Such a condition is ideal and might have a much more widespread adoption.

Granted that it is better to give a thing away than to destroy it and still better to sell it than to give it away, some thought should be given to the actual removal of the old ties. It has only been a matter of a few years that we have realized the destructive influence of a rotting piece of timber, but now that we do know it we should profit by our knowledge. A tie while still in track may be a very hotbed of dangerous fungus growths but just as long as the decayed portion remains in the ground it will be comparatively harmless. However, once the tie is removed and the fruiting bodies on the bottom and sides have a chance to scatter their spores to the wind, other timbers at a considerable distance may easily become infected with the fungi. For that reason extra care should be taken in keeping the old and the new ties separated. If possible, the old decayed ties should be taken out on the opposite side of the track from where the new ones are stored and either burned or hauled away before they can infect the sound timber. JAMES SWEENEY,

Supervisor of Track, Chicago & Eastern Illinois, Danville, Ill.

[For other views on the subject see page 364, *Railway Engineering and Maintenance* for September, 1924].

A Crane Mounted on a Motor Truck

A RECENT development in material handling equipment is a power-operated crane designed for mounting on an automobile truck, the effect of which is to produce a unit which can be moved freely from one place to another, and thus escape the usual limitations upon the use of cranes on work comprising a number of relatively small and scattered jobs. The illustration shows an installation of this character recently developed by the Orton & Steinbrenner Company, Chicago, which consists of a full revolving crane of the gasoline

The Truck Crane Loading Sand

which has a space between the driver's seat and the center of the rear axle of 8 ft., although the crane is more easily balanced if this distance is 8 ft. 6 in. This standard has been adopted owing to the fact that practically all late models of five-ton trucks provide this distance.

A feature of the design is the removable counterweight compartments provided. As the laws of some states do not permit loads in excess of 10 tons on hard surface roads the ballast necessary to maintain ths balance may be dropped out by simply opening the bottom of the compartment. Sand is generally used for ballast, since this is readily obtainable almost anywhere at practically no cost.

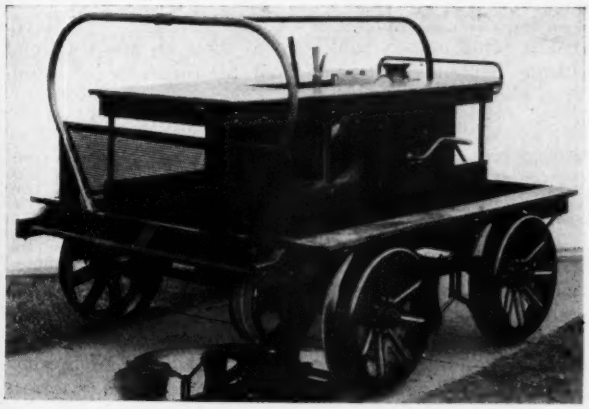
The construction of the crane itself is practically iden-

tical with the larger types of cranes manufactured by this company, with all wearing surfaces and bearings fitted with removable bronze bushings, with drums and sheaves of large diameter to reduce wear on the cables, with bronze cone frictions with outside hand brakes for operating the hoisting drums and for swinging the crane and with all-steel gears. The power is furnished by a four-cylinder 37-hp. motor with a Stromberg carbureter, a twin disc clutch, a Perfex radiator, a high tension magneto with impulse starter and a 30-gal. gasoline tank. Double drums are furnished on the main drum shaft and the power is supplied to both so that in handling buckets hoisting may be done with the bucket open or closed.

The crane will handle either a ½ or ¾ yard clam shell bucket and is sufficiently rapid in operation to run alongside and unload a car in an hour or less. Where desired, the bucket can be removed and a hook attached for handling sewer or water pipe, lumber, etc. The crane is also adapted for the installation of a generating set for operating a 36-in. electro magnet or handling scrap iron, pig iron, castings, etc. In fact, the entire design is adapted to producing a machine useful in all ordinary material-handling work. For railroad service the construction of the crane is such that when desired it can be detached from a motor truck and set up on a supply car, for example, for temporary use on the line.

A General Service Motor Car

MANUFACTURERS of railway motor cars have been confronted with much the same situation that has been met so effectively by the makers of automobiles, namely, a well-defined demand for equipment of low first cost and light weight combined with a perfection of details that will insure a high degree of servicability and low operating and maintenance expense. To meet



The Car As Equipped With One of the Types of Railing Which May Be Specified

this demand in the motor car field, Fairmont Railway Motors, Inc., Fairmont, Minn., is now introducing a new section car known as the S2 Economy car and in developing this design has followed the same principles which has been pursued in the production of popular priced automobiles, namely, the use of the standard engine unit with a long service record combined with designs for the frame, wheels, axles, etc., which lend themselves readily to quantity production.

The engine is the Fairmont 6-hp. one-cylinder two-cycle ball bearing, water cooled motor with sliding base and belt drive. The frame is of oak and may be had with one or three different types of safety railings and with or without a foot rail or toe board over the wheels. The wheels are 20-in. in diameter of cold drawn steel with malleable iron hubs fitting 1½-in. axles in Hyatt roller bearings. The axles are provided with adjustable thrust collars to take up side thrust. The weight of the car is 985 lb. with standard engine or 928 lb. with an aluminum water jack. The distribution of the weight of the car and engine is said to be such that two men can readily handle the car on and off the track. At the same time it has a seating capacity of from 8 to 10 men, it being the idea of the manufacturers to provide a car suited to the usual section service with a large force in the summer and a minimum force in the winter. According to the manufacturers the car will handle 11,000 lb. on level track, including the weight on trailers. The fuel performance is said to be from 25 to 30 miles per gal. of gasoline for normal operation on level track.

A Branding Iron for Dating Ties

A NEW device of definite application to railway maintenance of way work is illustrated in the accompanying photograph. It comprises a gas torch provided with suitable attachments by means of which the flame is made to impinge on a tool such as a soldering iron which may

The Everhot Torch Being Used for Dating Ties

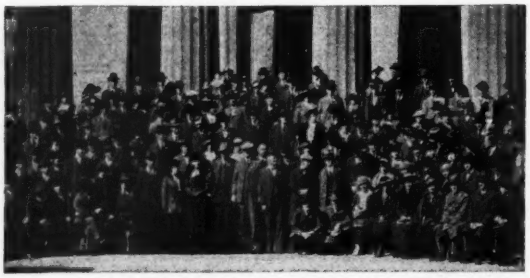
be used continuously because the flame maintains constant temperature of the iron. Its most valuable application of interest to the maintenance officer is the heating of branding irons for marking ties, timbers, tools, etc. For the branding of ties to supersede the use of dating nails the maintenance of the constant temperature by means of the gas torch is particularly advantageous since it permits the branding to proceed in the open air without interruption even when cold winds are blowing.

The branding attachment consists of a holder rigidly secured to the torch at the point of the flame with a suitable recess for inserting figures to indicate the date and such letters or other marks as are required to identify the species of wood, preservative treatment, etc. The removal of a set screw on one end of the recess permits the figures or letters to be removed and others inserted as required.

These branding torches are available in a number of different sizes but in the size most suitable for use in branding railroad ties the holder has space for five letters 1 in. high; seven letters ¾ in. high or eight letters of ½ in. The letters are set in the frame so that they cannot penetrate deeply into the wood, ⅛ in. being the approximate maximum depth of penetration, an amount which will not endanger the continuity of the sheath of impregnated wood in a treated tie yet sufficient to insure legibility of the mark throughout the life of the tie unless it is destroyed by accident.

In addition to branding ties the torch has been used for branding telegraph and telephone poles, shovel handles, etc. It is known as the Everhot torch, manufactured by the Everhot Manufacturing Company, Maywood, Ill.

With the Associations



American Wood Preservers' Association

The chief activities of the association during the present month embrace an evening meeting in connection with the convention of the Bridge and Building association at Kansas City, Mo. This is outlined in detail elsewhere in these columns. The nominating committee recently held a meeting, with the result that a list of members nominated for the next year's officers will probably be available for publication in the November issue.

Bridge and Building Association

Since the publication last month of the program for the thirty-fourth annual convention at the Baltimore hotel, Kansas City, Mo., on October 21-23, a number of important features have been added, which are listed below:

Tuesday, October 21

Address: W. A. McGonagle, president, Duluth, Missabe & Northern.

Address: R. H. Aishton, president, American Railway Association.

Tuesday Afternoon

Address: "The Place of a Bridge and Building Man in a Railway Organization," L. W. Baldwin, president, Missouri Pacific.

Tuesday Evening

Arrangements have been made for the holding of the Tuesday evening meeting jointly with the American Wood Preservers' Association, beginning with an informal dinner at 6:00 o'clock. As previously announced, the principal feature of this meeting will be the paper by C. S. Heritage, bridge engineer, Kansas City Southern, on The Fire Hazard of Treated Timber. The discussion will be led by C. M. Taylor, superintendent of timber preservation, Central Railroad of New Jersey, George E. Rex, vice-president of the National Lumber & Creosoting Company and I. L. Simmons and G. A. Haggander, bridge engineers, respectively, of the Chicago, Rock Island & Pacific and the Chicago, Burlington & Quincy.

Wednesday, October 22

Address: "The Effect of Maintenance on the Design of Railroad Bridges," John Lyle Harrington, consulting engineer, Kansas City, Mo.

Wednesday Afternoon

Address: "History of the Eads Bridge," Charles E. Smith, consulting engineer, St. Louis, Mo.

American Railway Engineering Association

Volume 25 of the proceedings of the association comprising a report of the convention held in March, 1923, has been issued to members. It is also expected to have in the mail within a week two bulletins containing supplements to the manual, which were adopted at the last convention. All committees are reported to be making progress with their respective assignments and some committees are prepared to hold their final meeting within a short time. At the present time Secretary Fritch, who is again in active charge of the association work after an absence because of ill health, is employed on the publication of a bulletin containing information of value developed by the committees other than that which is being prepared for presentation at the covention next year.

The Material Market

THE MARKET for iron and steel is showing renewed life a manifestation in which the railroads have played an important part. The roads are coming into the market for their 1925 requirements for rail and track supplies while orders for cars placed in recent weeks, together with the awarding of contracts on inquiries recently announced will soon bring the car orders for 1924 well up to the total for 1923. As the result of this increase in buying there has been an advance in the rate of production, estimated at between 55 and 60 per cent of capacity. Thus far the increased activity of the buyer has had no influence on prices, which have remained stationary or show even further declines, notably steel plates and bars. As noted in our general news columns, "Pittsburgh Plus" is now a dead issue. In the future prices will be quoted F. O. B. point of production. Following is a table of iron and steel prices covering items concerning the maintenance of way department:

PRICES PER 100 POUNDS

	August		September	
	Pittsburgh	Chicago	Pittsburgh	Chicago
Track spikes	$2.80	$2.80 to $3.00	$2.80	$2.80 to $3.00
Track bolts	3.75	3.80 to 4.00	3.75	3.80 to 4.00
Angle bars	2.75	2.75	2.75	2.75
Tie plates, steel	2.50	2.45	2.50	2.45
Boat spikes	3.25	3.59	3.25	.....
Plain wire	2.55	2.89	2.55	.....
Wire nails	2.80	3.14	2.80	.....
Barb. wire, galv.	3.50	3.84	3.50	.....
C. I. Pipe, 6 in. to 12 in., ton	.....	53.20	.....	53.20
Plates	1.90 to 2.00	2.00 to 2.15	1.80 to 2.00	2.10 to 2.15
Shapes	2.00 to 2.15	2.10 to 2.15	2.00 to 2.10	2.10 to 2.15
Bars, soft steel	2.10 to 2.15	2.10 to 2.15	2.00 to 2.10	2.00 to 2.10
Rivets, struct.	2.60	.....	2.60	.....
Open hearth rails, per gross ton, f. o. b. Mills				$43.00

The scrap market continued to show an upward trend during September, as indicated by the table of scrap prices below:

PRICES PER GROSS TON AT CHICAGO

	August	September
Relaying rails	$27.00 to $32.00	$27.00 to $32.00
Rails for rerolling	16.00 to 16.50	17.50 to 18.00
Rails less than 3 ft. long	17.50 to 18.00	18.50 to 19.00
Frogs and switches cut apart	15.50 to 16.00	16.50 to 17.00
Steel angle bars	17.00 to 17.50	18.00 to 18.50

Orders for lumber continue on approximately the same basis as a year ago, with some tendency toward renewed activity and with prices the same or slightly higher than a month ago. On the west coast where business has been rather quiet the relation of demand to production has been maintaind by the consistent curtailment of production. The following table shows a comparison of prices for August and September on typical lumber items:

SOUTHERN PINE MILL PRICES

	August	September
Floorings, 1x4, B and B flat	$42.00	$41.25
Boards, 1x8, No. 1	33.20	35.30
Dimension, 2x4, 16, No. 1, common	26.20	26.90
Dimension, 2x10, 16, No. 1, common	26.80	27.45
Timbers, 4x4 to 8x8, No. 1	25.70	26.80
Timbers, 3x12 to 12x12, rough	32.95	33.45

DOUGLAS FIR MILL PRICES

Flooring, 1x4, No. 2, clear flat	$30.00	$29.00
Boards, 1x8, 6 to 20, No. 1, common	16.50	17.50
Dimension, 2x4, 16, No. 1, common	16.50	18.50
Dimension, 2x10, 16, No. 1, common	16.00	18.00
Timbers, 6x6 to 8x8, No. 1, common	23.00	23.00
Timbers, 10x10 to 12x12, rough	18.00	18.00

The prices for Portland cement have been fairly steady, only two or three changes being noted which in part, at least, are the result of adjustments of freight rates:

New York	$2.15	Minneapolis	$2.42
Pittsburgh	2.19	Kansas City	2.70
New Orleans	2.80	Dallas	2.05
Chicago	2.20	Denver	2.84
Cincinnati	2.47	San Francisco	2.61

News of the Month

The Wisconsin Supreme Court has recently held that a railroad which is maintaining a siding for a shipper is liable for the death of a passenger if killed in a collision between a train and loaded freight cars which escaped from the siding when the track is down grade and no derailing device is provided. The contention that the siding was a private track belonging to the shipper was held to be no defense.

A railway technical congress will be held in Berlin from September 21 to October 5 under the auspices of the Society of German Engineers in connection with which an exhibition is to be held of more than 100 different locomotives of the most modern construction, rail motor cars for standard and narrow-gage railway, special demonstrations of equipment, etc.

The safety exhibit of the Missouri-Kansas-Texas, shown at the Missouri State fair at Sedalia, Mo., last month and which is to be shown at other fairs in cities along the lines of that road, included a "human interest" feature in the person of Layland Myatt of Burleson, Tex., a boy of 14 years who lost one of his legs by trying to board a moving freight train at Fort Worth four years ago.

In 1914 only 528,703 tons or 27 per cent of the rail rolled in United States and Canada was of 100 lb. or heavier section. In 1923 the rail of this weight comprised 1,465,850 tons or 51 per cent of the total amount of rail rolled, according to statistics of the American Iron & Steel Institute. These figures show that in nine years the tonnage of 100 lb. or heavier section nearly trebled while the percentage was almost doubled.

A total of 375 special trains were dispatched from Wenatchee, Wash., to St. Paul, Minn., during the season of 1923-24 to carry the fruit shipped from the Wenatchee district to eastern markets. In these trains, which were operated over the Great Northern, were 15,337 carloads or an average of 40 cars per train. The contents of these trains consisted almost entirely of apples, the average number of cars of other fruit being not over one car to a train. The total movement of apples from the Wenatchee district during that season amounted to 18,164 cars.

The International Railways of Central America, with 600 miles of railway located in the Republics of Guatemala and Salvador, form the largest American private owned railway enterprise outside the United States at present. The lines of this company form, with a few minor execptions, the entire railway system of these countries. They penetrate the traffic-producing territory in such a way as to form the backbone of all agricultural and commercial activities. The lines are of three-foot gage, except 16 miles, with maximum grades of three per cent.

The Operating Revenues of the Class I railroads operating 235,725 miles of line was $54,714,400, or 10.2 per cent, less in July, 1924, the last month of record, than the same month of last year, while operating expenses were 10.9 per cent less. The net operating income for the first seven months of this year was at the annual rate of return of 4.07 per cent on the property investment as compared with 4.83 per cent for the same period last year. Twenty-seven Class I carriers operated at a loss in July of which ten were in the eastern district and 17 in the western district. There was a reduction of $108,172,000, or more than eight per cent in the maintenance expenses as compared with the corresponding period of last year. For maintenance of way alone there was a reduction in July of this year of $3,447,000 or 4.5 per cent as compared with July, 1923.

One of the heaviest pieces of railway construction ever undertaken in Illinois is being pushed to completion on the Beardstown division of the Chicago, Burlington & Quincy for the purpose of eliminating a pusher grade in the Burlington's northbound coal movement from southern Illinois. It comprises the building of about 17¼ miles of new line from a point two miles north of Beardstown, Ill., to Vermont. The completion of the line which will cost approximately $143,000 a mile, will give the Burlington a continuous 0.3 per cent northbound ruling grade over a distance of 682 miles to St. Paul, Minn.

Eleven Sizes of steel reinforcing bars, based on the area of the bars, were adopted as standard to govern the manufacture of this material at a recent meeting of steel manufacturers, distributing interests and representatives of the Associated General Contractors of America and other consumers, held in the Division of Simplified Practice of the Department of Commerce. The cross sectional areas in inches of the standards adopted are: .049, .110, .196, .250, .307, .442, .602, .785, 1.000, 1.266, 1.563. This action, effective on January 1 for producers and on March 1 for distributors who have stocks or current orders to be cleared before the completion of the action, will replace some 40 or more sizes in present use.

In a formal notice filed with the Federal Trade Commission on September 17 the United States Steel Corporation and its various subsidiaries announced their compliance with the order abolishing the Pittsburgh plus system of quoting prices of rolled steel products, thus abandoning their original intention to carry the case into the United States Courts. While the validity of the order or the jurisdiction of the committee is not admitted the inference given is that the public sentiment against the continuance of the system, under which prices have been quoted on the Pittsburgh basis plus the freight from Pittsburgh to the place of manufacture, has become so strong as to make the continuation of the fight further ill advised.

Since July there has been a considerable improvement in car loadings, according to the records of the Car Service division of the American Railway Association. Not only have they been larger than in June and July but they have approached more nearly the high record attained in August, 1923. In the four weeks ended August 23, they averaged 72,000 a week less than in the corresponding week of August, 1923, but averaged 74,000 a week more than in July of this year. In the week ending August 30 car loading exceeded the million mark for the first time this year, with a total loading of 1,020,339 cars, which was only 71,811 cars less than the corresponding week of 1923. The improvement in general conditions as indicated by the increase in car loadings is producing an effect upon railway purchases. In the first four months of 1924 the railways placed orders for 71,420 freight cars, or an average of 17,850 a month. In May, June and July they placed orders for only 1,355 freight cars, or an average of 448 a month. In August they placed orders for 4,751 freight cars, with inquiries for a large number of additional cars, while recent inquiries for rail aggregate more than 500,000 tons.

Personal Mention

General

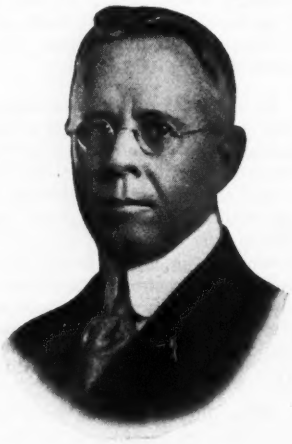
John Foley, forester of the Pennsylvania system, has been appointed chairman of the Consulting Committee on Standardization of Hard Woods under the Central Committee on Lumber Standardization. This committee will undertake the simplification of production concerning the manufacture and merchandizing of hardwood along the lines already pursued with respect to softwoods.

H. O. Kelley, division engineer on the Peru division of the Wabash, who has been appointed general manager of the Toledo & Western, with headquarters at Sylvania, Ohio, as announced in the September issue received his education in civil engineering at Rose Polytechnic Institute, and entered railway service in 1913 in the engineering department of the Chicago & Eastern Illinois. He was appointed engineer maintenance of way of the Evansville & Indianapolis in 1916 and remained in that position until 1918, when he was appointed assistant engineer on the Wabash. Mr. Kelley was promoted to division engineer of the St. Louis terminal in 1919 and in the following year was appointed special engineer. He was appointed division engineer of the Western division in 1921 and in 1923 was transferred to the Peru division. He remained in this position until his recent appointment as general manager of the Tolego & Western.

Engineering

P. B. Jeffries has been appointed chief engineer of the Alabama & Vicksburg, with headquarters at New Orleans, La.

W. J. Bergen, chief engineer and valuation engineer of the New York, Chicago & St. Louis, with headquarters at Cleveland, Ohio, has been appointed engineering assistant to the president and valuation engineer, with the same headquarters, a newly created position. **J. K. Conner,** chief engineer of the Lake Erie & Western district, with headquarters at Indianapolis, Ind., has been appointed also chief engineer of the Nickel Plate district, with headquarters at Cleveland, succeeding Mr. Bergen. **A. C. Harvey,** assistant chief engineer of the Nickel Plate district, with headquarters at Cleveland, has been appointed also assistant chief engineer of the Lake Erie & Western district, with the same headquarters. **J. C. Wallace,** structural engineer of the Lake Erie & Western district, with headquarters at Indianapolis, has been promoted to district engineer, with the same headquarters, a newly created position.



W. J. Bergen

Mr. Bergen was born on February 16, 1872, at Waterbury, Conn. He graduated from Rensselaer Polytechnic Institute, Troy, N. Y., in June, 1897, and entered railway service in May, 1899, as assistant to division engineer on construction with the Burlington & Missouri River, now a part of the Chicago, Burlington & Quincy, in Nebraska. In July, 1899, he was appointed levelman on location and in January, 1900, he was promoted to division engineer on construction. He was appointed assistant engineer of the New York, Chicago & St. Louis, in July, 1901, and held this position until January, 1907, when he was promoted to chief supervisor of track. He was promoted to first assistant to the chief engineer, in August, 1907, and to engineer in charge of grade elimination in December, 1916. In October, 1918, he was promoted to chief engineer, remaining in that position throughout the period of federal control. He was appointed consulting and valuation engineer in March, 1920, and in April, 1924, was again appointed chief engineer, which position he was holding at the time of his present appointment.

G. S. Kibbey, assistant engineer on the Minneapolis & St. Louis, with headquarters at Minneapolis, Minn., has resigned to engage in contracting business in California.

Frank Kirk, master carpenter on the Chicago, Rock Island & Pacific, with headquarters at Estherville, Iowa, has been promoted to the newly created position of division engineer of the Dakota Division, with the same headquarters.

W. S. Johns, Jr., supervisor on the Pittsburgh division of the Pennsylvania, with headquarters at Trafford, Pa., has been promoted to acting division engineer of the Akron division, with headquarters at Akron, Ohio, succeeding **H. J. Shaw,** who has been given a leave of absence on account of ill health.

W. O. Cudworth, assistant in the district engineer's office on the Canadian National, with headquarters at North Bay, Ont., has been promoted to division engineer of the Sudbury division, to succeed **J. R. Paswell,** who has been transferred to the Smith Falls division at Sudbury, Ont., to succeed **J. H. Forbes;** transferred to Montreal. **Major General Charles F. Draper,** assistant engineer on special work on the Canadian National, has been appointed engineer of grade separation at Toronto, Ont.

Frank C. Huntsman, whose promotion to division engineer on the Wabash, with headquarters at St. Louis, Mo., was reported in the September issue, entered railway service in 1906 as a draftsman on location on the Chicago, Burlington & Quincy. He was subsequently employed on the Burlington in various positions on location, construction and maintenance, until 1919, when he resigned to enter the service of the Wabash as assistant engineer at Springfield, Ill., the position he was holding at Moberly, Mo., when recently promoted to division engineer.

Track

J. A. Walsh has been appointed acting roadmaster of the third roadmasters' district on the Atchison, Topeka & Santa Fe, with headquarters at Parker, Ariz., to succeed **H. L. Hoskins,** who has been transferred to Needles, Cal.

W. R. Parvin, assistant supervisor on the Pittsburgh division of the Pennsylvania, with headquarters at Derry, Pa., has been promoted to supervisor on the Monongahela division, with headquarters at Youngwood, Pa., effective August 26. **C. H. Frick,** assistant supervisor on the Renovo division, with headquarters at Erie, Pa., has been transferred to Derry, succeeding Mr. Parvin, and the position of assistant supervisor at Erie has been abolished. **W. E. Baker,** supervisor on the Monongahela division, with headquarters at Youngwood, Pa., has been transferred to the C. & P. division, with headquarters at Cleveland, Ohio, effective August 26, succeeding **D. J. McCormack,** transferred.

J. F. Gallagher has been promoted to roadmaster on the Suisun district of the Southern Pacific with headquarters at Suisun, Cal. to succeed J. B. Bickford who has been assigned to other duties.

Thomas Olds has been promoted to roadmaster of the Fifth district of the Spokane division of the Great Northern with headquarters at Marcus, Wash., to succeed **F. C. Hanneman,** who has been promoted to division roadmaster, with headquarters at Spokane, Wash., to succeed **M. Johnson,** resigned. **J. E. Clapp,** district roadmaster at Wenatchee, Wash., has been transferred to the First district of the Spokane division, with headquarters at Hillyard, Wash., to succeed **Ivor Nelson,** resigned.

E. D. Flad, supervisor on the Renovo division of the Pennsylvania, with headquarters at Emporium, Pa., has been transferred to the Pittsburgh division as acting supervisor, with headquarters at Trafford, Pa., succeeding **W. S. Johns, Jr.,** who has been promoted as noted elsewhere in this issue.

W. S. Kemmerer, assistant supervisor on the Pittsburgh division, with headquarters at Johnstown, Pa., has been promoted to acting supervisor on the Renovo division, with headquarters at Emporium, Pa., in place of Mr. Flad. **R. J. Moore,** assistant supervisor on the Pittsburgh division, with headquarters at Kittanning, Pa., has been appointed acting assistant supervisor at Johnstown, Pa., relieving Mr. Kemmerer. **I. S. Pringle,** acting assistant supervisor on the Allegheny division, with headquarters at Titusville, Pa., has been transferred to Kittanning, succeeding Mr. Moore. **D. M. Howard,** assistant supervisor on the Wheeling division, with headquarters at Wheeling, W. Va., has been appointed acting assistant supervisor at Titusville, and the position at Wheeling has been abolished.

W. E. Graham, general foreman of track on the Baltimore & Ohio, Western lines, at Grafton, W. Va., has been promoted to track supervisor at Mansfield, Ohio, to succeed **J. W. Sharp,** who has been transferred to Zanesville, Ohio, succeeding **C. A. Nunes,** who has been transferred to the Newark division upon the resignation of **C. H. Royer.**

W. E. Graham was born in Louisville, Ky., on August 31, 1890, and entered railway service in 1910 as an employee on location and construction work on the Louisville & Nashville. He left the Louisville & Nashville in 1915 as a resident engineer to become a transitman on construction work on the Southern and was so engaged until 1916 when he became topographer in the valuation department of the Baltimore & Ohio, where he was advanced a few months later to chief of a division valuation party. Early in 1917 he entered the maintenance department as an assistant supervisor but resigned soon after to become division engineer on construction on the Atlantic Coast Line. He was promoted to superintendent of construction in 1920 and subsequently became trainmaster, in which capacity he served until November, 1923, when he re-entered the service of the Baltimore & Ohio, where he was serving as general foreman on the construction of double track at the time of his recent appointment.

R. A. Morrison, assistant track supervisor on the Toledo division of the Pere Marquette, has been transferred to the Port Huron-Grand Rapids division, with headquarters at Saginaw, Mich., co-incident with the transfer of **S. F. Smith,** track supervisor on this division at Saginaw, to the Ludington division, with the same headquarters, to succeed **Elmer Anderson,** resigned.

Bridges and Buildings

P. T. Swenson, superintendent of bridges and buildings on the Minneapolis, St. Paul & Sault Ste. Marie, with headquarters at Minneapolis, Minn., has not been retired, as reported in error in the September issue.

Purchasing and Stores

Elmo Edwards has been purchasing agent and general storekeeper of the Spokane, Portland & Seattle, with headquarters at Portland, Ore., succeeding Paul McKay, who has resigned to accept service with another company.

B. M. Winegar, assistant general tie agent of the Canadian Pacific, with headquarters at Montreal, Que., has been appointed general tie agent, with the same headquarters, succeeding **Thomas Walker,** deceased.

The New York, New Haven & Hartford has announced the beginning of preparations for the electric operation of its line from South Norwalk, Conn., northward to Danbury, a distance of 24 miles, and on the Ridgefield branch for 4 miles. This work will complete the electrification of the New York division.

The standards for the storage and operation of gasoline and electric trucks in freight houses, warehouses, which were adopted last year by the Railway Fire Protection Association, have been made the subject of a circular, Bulletin No. 13, which is being distributed by the Railroad Insurance Association, 80 East Maiden Lane, New York City.

Construction News

The Atchison, Topeka & Santa Fe, has called for bids for the construction of an addition to its storehouse at La Junta, Colo., to cost approximately $80,000 and for an addition to the lavatory building, to cost $5,000.

This company contemplates the construction of locomotive and car shops at Prescott, Ariz., to cost approximately $100,000.

This company has called for bids for the construction of a passenger station at Canyon, Tex., and for the construction of an addition to the powerhouse at Amarillo, Tex. This company closed bids on August 22 for the construction of a brick passenger station at Plattsburg, Mo., and has awarded a contract to the Sumner Sollitt Company, Chicago, for the construction of a three-story ice manufacturing and storage plant at Winslow, Ariz., reported in the June issue.

The Baltimore & Ohio has awarded a contract to the American Bridge Company for two new spans in a railroad bridge at Opequon, near Martinsburg, W. Va., including approximately 100 tons of steelwork, and has awarded contracts to the Seaboard Construction Company, for the construction of three small bridges, one each on its Mt. Clare branch, its Relay branch and its Curtis Bay branch—all near Baltimore, Md., to cost approximately $65,000, and for new bridges at Bessemer, Pa., and Laughlin Junction, Pa., requiring approximately 600 tons of steel.

The Boston & Maine has authorized improvements to its engine terminal at Springfield, Mass., to cost approximately $44,000.

The Canadian National has awarded a contract to the Hamilton Construction Company, Moose Jaw, Sask., for the construction of a six-stall addition to the enginehouse at Nutana, Sask.

This company has been granted a permit for the erection of a stores building at Point St. Charles shops, Montreal, Que., at a reported cost of $80,000 and has been authorized to proceed with considerable bridge work including the following: The rebuilding of the bridge over the Rouge river near Rosebank, which involves the replacement of the present 140-ft. double-track truss span by a heavier structure; the replacing of the present 160-ft. double-track truss span over the Camden river near London, Ont., with a heavier span; the reconstruction of 200-ft. of plate girder bridge on new concrete piers over the Indian river on the Capreol division on the Northern Ontario district; and the replacing of a 500-ft. trestle over the Kenogami river on the Hornepayne division with 290 ft. of fill and 210 ft. of reinforced concrete pile trestle.

The Central of Georgia is to have an icing station erected by outside interests somewhere on its lines in Middle Georgia to cost approximately $1,000,000.

This company has awarded a contract to the Claussen-Lawrence Construction Company, Augusta, Ga., for the construction of a passenger station with shelter sheds at Opelika, Ala.

The Chicago, Burlington & Quincy has begun the construction of extensions to its freight facilities at Denver, Colo., the project including approximately eight miles of additional track, two freight buildings and two loading platforms. It is estimated that the work will cost approximately $300,000.

The Chicago, Rock Island & Pacific has asked the Interstate Commerce Commission for authority to construct an extension of the proposed extension from Billings to Owens, Okla., pending in another proceeding. The projected extensions will constitute a continuous line from Billings, where the existing branch line now terminates, to Ponca City, Okla., the location of the Tonkawa oil field. The extension from Owens to the new terminus at Ponca City will be approximately 20 miles in length.

The Fort Wayne Union recently organized at Fort Wayne, Ind., has awarded a contract to P. T. Clifford & Sons, Val-

paraiso, Ind., for the construction of a belt line at Fort Wayne, to cost approximately $200,000.

The Fort Worth & Denver City has closed bids for the construction of a roundhouse at Childress, Tex.

The Grand Trunk Western has awarded a contract to W. E. Clebo, Grand Rapids, Mich., for the construction of a two-story freight house at Port Huron, Mich.

The Gulf Coast Lines contemplates the construction of a passenger station at Brownsville, Tex.

The Illinois Central has closed bids for the construction of a 600-ton concrete coaling station at Dawson Springs, Ky., and has awarded a contract to Joseph E. Nelson & Sons, Chicago, for the construction of a concrete viaduct in connection with the grade separation project at North Baton Rouge, La., to cost approximately $75,000. A contract has also been awarded to George W. Turner & Co., Memphis, Tenn., for the grading in connection with the construction of second track from Corinth, Miss., to Ruslor, to cost $40,000.

The Lubbock & Western, of which J. A. Wilson of Lubbock, Texas, is the promoter, is planning the construction of a line from Lubbock, Texas, to Roswell, New Mex., a distance of approximately 150 miles.

The Missouri Pacific has awarded a contract to Jerome A. Moss, Chicago, for approximately 100,000 cu. yd. of grading at Kansas City, Mo.

This company has applied to the Interstate Commerce Commission for authority to construct an extension of the Eudora branch from Epps to Delhi, La., 10 miles.

The New York Central has awarded contracts to the Walsh Construction Company for the following: Tunnel elimination 2¼ miles north of Camelot, N. Y., $174,000; replacement of a bridge at Beaver River, N. Y., $194,000. A contract for the reconstruction of a highway bridge to cost approximately $82,000 at Hoffmans, N. Y., has been awarded to William M. Ballard Company.

This company has awarded a contract to the Austin Company, Chicago, for the construction of a one-story car repair shop, 90 ft. by 130 ft., at Hammond, Ind., to cost approximately $45,000. This road also has awarded a contract to Louis Chevalier, Inc., for the elimination of grade crossings at Main and Wildey streets, Tarrytown, N. Y., to cost $227,000. Grade crossings at Court street, Town Line road and Hazelhurst avenue, East Syarcuse, N. Y., will be eliminated at a cost of $59,000 by Wm. M. Ballard. A contract has been awarded to the Walsh Construction Company for grade revision and elimination of grade crossings between Ridgefield Park, N. J., and Teaneck on the company's West Shore line to cost approximately $300,000.

The New York, Chicago & St. Louis has awarded a contract to the Erie Steel Construction Company, Erie, Pa., for the construction of an addition to its shops at Conneaut, Ohio, and plans the construction of a freight station at Fort Wayne, Ind.

The Pennsylvania has purchased land at its intersection with Main street in Toledo, Ohio, for the separation of a grade at that point.

This company has awarded a contract to the Brown-King Construction Company, Philadelphia, for the reconstruction of a overhead bridge at Lemoyne, Pa., to cost approximately $80,000. A contract has been awarded to the Columbia Contracting Company, Altoona, Pa., for the construction of concrete roadways at the company's new Juniata shops, to cost approximately $30,000; to Henry Steers, Inc., New York, for the construction of a new float bridge and other waterfront improvements at Greenville, N. J., $500,000; to the Ben Neuendorf Company, Chicago, for masonry for a subway at Ogden avenue, Chicago, $50,000; to the Wilson & English Construction Company, New York, for the construction of a reinforced concrete viaduct to eliminate a grade crossing at Vail, Pa., $40,000; to the Brann & Stuart Company, Philadelphia, for the construction of an overhead bridge to eliminate a grade crossing at Croyden, Pa.

The Rio Grande City has been authorized to construct a line from Samfordyce to Rio Grande City, Tex., approximately 22 miles, using material purchased from the federal government, which had planned the construction of such a line during the war to serve the military reservation at Fort Ringgold.

The San Antonio & Mexican has been issued authority for construction of a line from a point near Three Rivers to a point near Fowlerton, Tex., about 40 miles, but has withheld its approval of a proposed line from Fowlerton to Mirando, Tex., 74.4 miles and of a proposed branch of 55.3 miles to Laredo.

The Seabrook Electric, which has recently been incorporated at Houston, Tex., proposes the construction of an interurban line from Houston, Tex., to Seabrook, a distance of 30 miles.

The Southern has called for bids for the construction of a 26-stall roundhouse at Asheville, N. C.

The Union Pacific plans the construction of a freight station at Glendale, Cal., to cost approximately $150,000. The building will be 32 ft. by 90 ft. and of tile and stucco construction. A concrete loading platform and auto dock and 43,000 sq. ft. of brick and concrete driveways are included in the plans.

The Wabash has awarded a contract to Hugh J. McDonald, Decatur, Ill., for the construction of an addition to the Wabash Employees' Hospital at Decatur, to cost $77,000. The addition will be 40 ft. by 140 ft. and two stories in height.

Supply Trade News

The Neff & Fry Company, Camden, Ohio, a manufacturer of concrete stave coal pockets, has organized a railway sales department with offices in the Frisco building, St. Louis, Mo.

Gordon H. McCrae, manager of the London office of the Independent Pneumatic Tool Company, has been elected a vice-president of the company.

H. C. Storr of the general sales department of S. F. Bowser & Company, Ft. Wayne, Ind., has been promoted to assistant sales manager, with the same headquarters.

The Southwest Sales & Equipment Company, Los Angeles, Cal., has been appointed representative for the **Orton & Steinbrenner Company,** Chicago, to handle the latter's products in southern California, Arizona and New Mexico.

The National Railway Appliance Company of New York, with offices at Boston and Washington, and the **Hegeman-Castle Corporation** of Chicago, have been appointed general sales agents of the **Walter Tractor Snow-plow.**

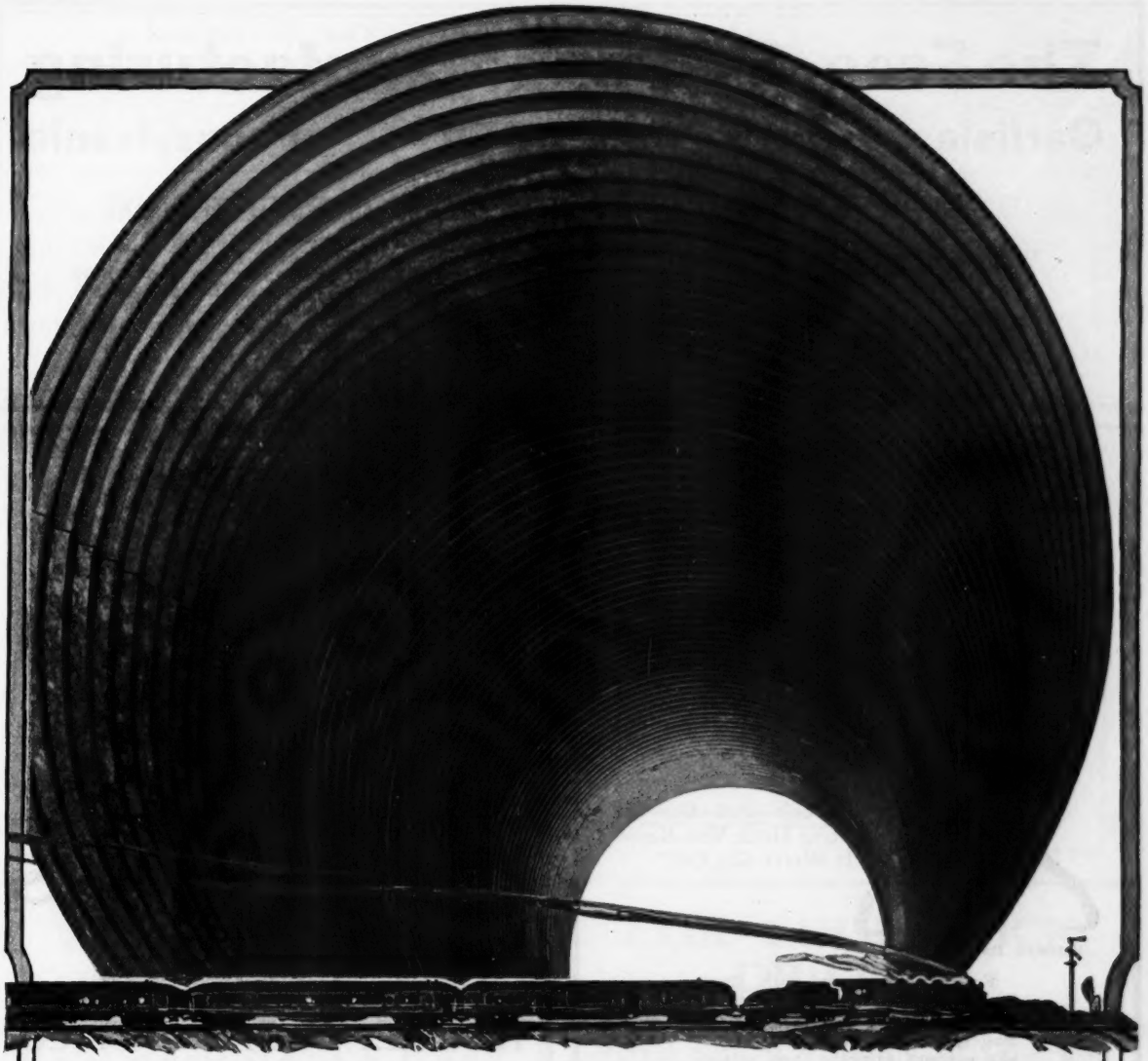
Ralph W. Payne has been appointed southern sales agent of the Verona Tool Works, Pittsburgh, with headquarters at the Metropolitan Bank building, 613 Fifteenth street, N. W., Washington, D. C.

R. L. Mead, engineer and salesman for the Brown Hoisting Machine Company, has been appointed western sales manager of the **Ohio Locomotive Crane Company,** with headquarters in the Railway Exchange building, Chicago.

E. R. Mason, 1845 Grand Central Terminal, New York City, has been appointed district sales manager, in charge of sales in all the New England states, also in New York, New Jersey, Pennsylvania and Delaware, for **Fairmont Railway Motors, Inc.,** Fairmont, Minn.

C. R. Chadbourne, assistant division engineer of the Mastic division of the **Barber Asphalt Company,** Philadelphia, Pa., has been appointed district manager of the Chicago territory of the **Republic Creosoting Company,** with headquarters in the Strauss building, Chicago.

The Pawling & Harnischfeger Company, Milwaukee, Wis., has appointed **P. H. Sackett** to represent the company in Minnesota, North Dakota and South Dakota. Mr. Sackett's headquarters will be at 3445 Hennepin Avenue, Minneapolis, Minn. He will handle all of the company's business in the territory stated above.



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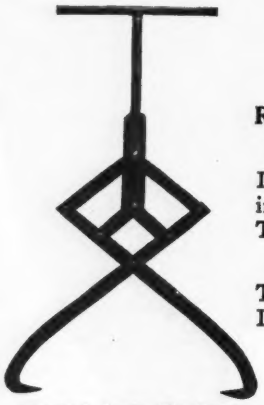

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Indianapolis, Ind., 911 Hume-Mansfeur Bldg.

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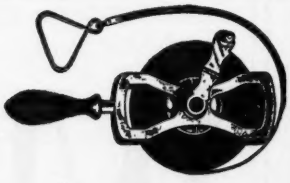

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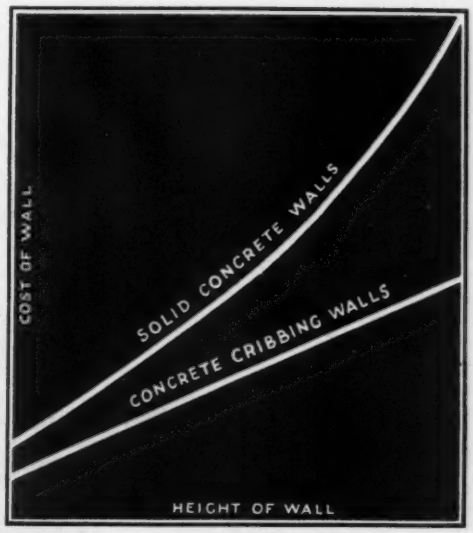

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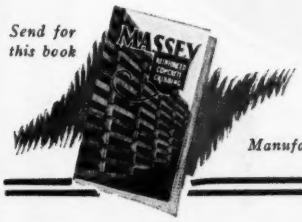

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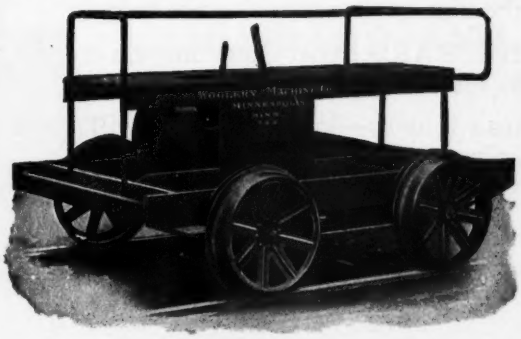

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WOOLERY MACHINE CO., Minneapolis, Minn.

FOR YOUR ROCK DRILLING

—in maintenance or on construction, you'll find it a saving of time and labor to own a few

SULLIVAN ROTATORS

These powerful but light (38-lb.) air hammer drills will handle any rock work you meet. They are fast drillers and are always on the job.

7 models

(1 steam)

Ask for Bulletin 1981-B

SULLIVAN TRADE MARK REG. U.S. PAT. OFF.

MACHINERY COMPANY

411 Peoples Gas Bldg. Chicago

Buy It!

Specify HUBBARD SUPER-STEEL SHOVELS on your next order.

Buy it, not because it is nationally advertised, which it is NOT,—not because it is good looking, which it IS—but, because, compared with any shovel at any price, subjected to any comparative test—it is the best quality shovel made today.

We claim HUBBARD Super-Steel Shovels are the best shovels made today, anywhere.

You can throw it away—loose it—but, it will stand hard wear, always.

HUBBARD *superst*

A heat treated chrome molybdenum all

Use It!

Put it on your hardest jobs—dig, pound, pry or lift with it—compare its performance and life with any shovel—

Do this—put it in service and you will agree that here truly is a fine shovel—one made to last, and wear and please both the workmen and the buyer.

HUBBARD AND COMPANY
Pittsburgh, Pa.

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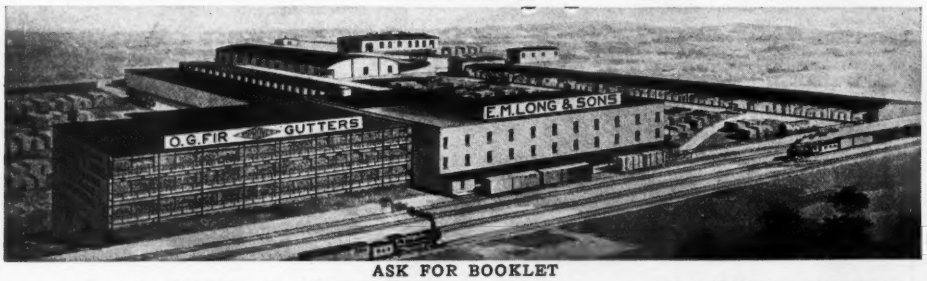
um alloy steel shovel

O. G. FIR GUTTER

E. M. LONG & SONS CADIZ, OHIO IMPROVED O. G. FIR GUTTERS REG. U.S. PAT. OFFICE



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E. M. LONG & SONS - - CADIZ, OHIO

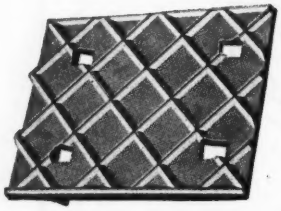
HALF MILLION FEET
Carried in Stock

Sizes
3 x 5
4 x 6
5 x 7

Lengths
10 to 40 Feet

LOOK BETTER
LAST LONGER
LESS EXPENSIVE

Sellers Anchor Bottom



Wrought Iron Tie Plates

Efficient
- Hold track to gauge
- Seat square to the rail
- Do not injure the tie
- Stop season checks in tie
- Bottom ribbing is a truss equal to one sixteenth inch additional solid section

Durable
- Rolled end over end
- Never break
- Made of Wrought Iron—corrosion retarded

Made in all sizes—with level or tapered rail seat, and with or without crown or cambre

SELLERS MANUFACTURING COMPANY
Illinois Merchants Bank Bldg., Chicago, Ill.

Tired of digging up rusted-out small pipe?

Use McWane Cast Iron pipe next time—made as small as 1¼ and 2 inches. Factory-made Precalked Joints make laying easy.

Write today for booklet R and prices.

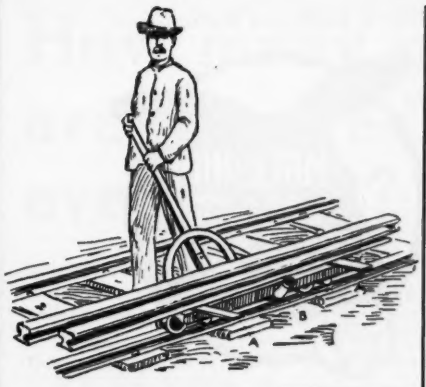
McWane Cast Iron Pipe Co.

Birmingham Philadelphia
Los Angeles
Dallas

McWANE PRECALKED JOINT PIPE CAST IRON

We sell derailing service; we make it our business to help you get good results from every Hayes Derail you have all the time it is in track. There is a Hayes Derail for every need. The sliding type with three point bearing called Model H is in most demand and is the best all around derail. It is for operation by pipe line, by switch stand or direct by hand. Hayes Derails are in wide use on nearly every railroad in North America.

Hayes Track Appliance Co., Richmond, Indiana



EACH CAR A LABOR SAVER

Pony Car and Skid Set.

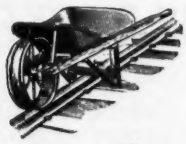
American Trackbarrow.

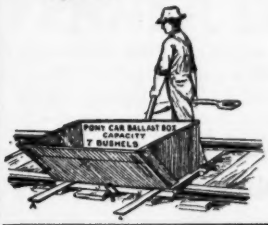
Pony Car Skid Set Ballast Box.

Carbarrow.

Dandy Car.

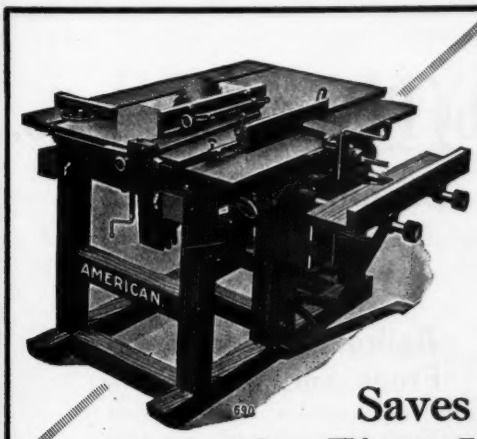
Pony Car without Skid Set.





American Trackbarrow one-rail maintenance cars are economical, durable and useful. Easy to handle, safe and great labor savers. All of which make work a pleasure. Cheerful men do more and better work.

THE AMERICAN TRACKBARROW, Box 445, Lowell, Mass.



Saves its cost on the First Job

This American Portable Variety Woodworker lets you do any woodworking operation of either a routine or special nature right on the job. Figure the saving over hand or shop work! Hundreds are now in use.

This one machine may be used as a rip or cut-off saw, as a dado, gaining, grooving, rabbiting, tenoning or boring machine, as a jointer or planer, a matcher, molder or sander and as a hollow chisel mortiser.

Let us send you our Bulletin No. 80 describing our full line of Woodworking Machines for use on the job or in the shop.

American Saw Mill Machinery Co.
164 Main Street, Hackettstown, N. J.
"American" Saw Mills and Woodworkers

The Blaw-Knox SINGLE LINE Bucket

hook it on

—REPLACE HAND LABOR

When unloading cars of coal, sand, etc.; cleaning up slag, debris—any kind of work.

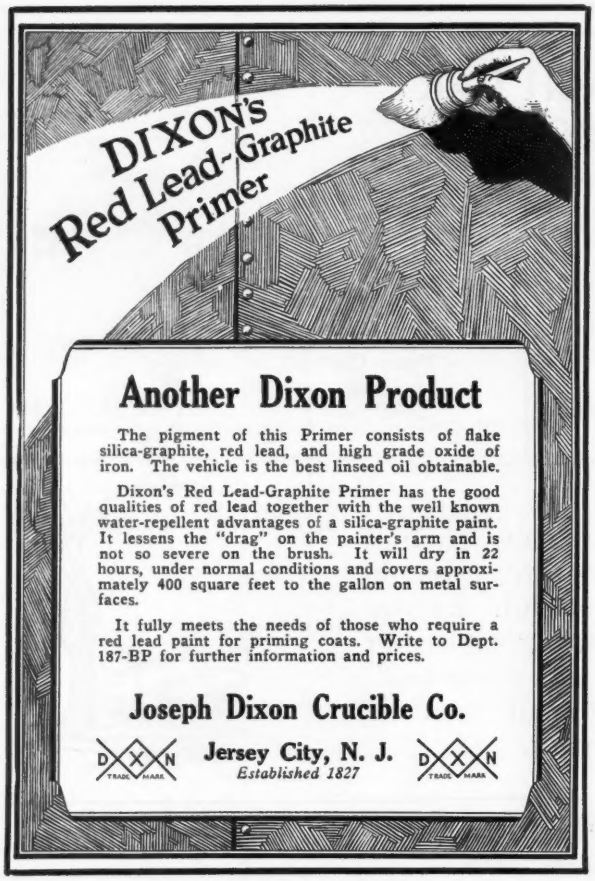
When you have bucket work to do — throw the yoke of the closing line over the crane hook and go to it.

When through — set the bucket aside and let the crane be on its way.

Send for our new booklet—descriptive of the SINGLE LINE.

BLAW-KNOX COMPANY
639 Farmer's Bank Building
Pittsburgh, Pa.

BLAW-KNOX BUCKETS



Another Dixon Product

The pigment of this Primer consists of flake silica-graphite, red lead, and high grade oxide of iron. The vehicle is the best linseed oil obtainable.

Dixon's Red Lead-Graphite Primer has the good qualities of red lead together with the well known water-repellent advantages of a silica-graphite paint. It lessens the "drag" on the painter's arm and is not so severe on the brush. It will dry in 22 hours, under normal conditions and covers approximately 400 square feet to the gallon on metal surfaces.

It fully meets the needs of those who require a red lead paint for priming coats. Write to Dept. 187-BP for further information and prices.

Joseph Dixon Crucible Co.

Jersey City, N. J.
Established 1827

"Not a Kick in a Million Feet"

IT STANDS THE RACKET

Why are Mulehide protective products (Roofing, Insulating material, etc.) bought year after year by ninety per cent of the railways entering Chicago?

The only reason we know is that Mulehide products contain that extra toughness which enables them to stand the extra punishment which railway service gives.

Manufactured by

THE LEHON COMPANY

44th to 45th Street on Oakley Ave.,
Chicago, Ill.

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A TYPE FOR EVERY SERVICE

Bulletins on request

THE GOULDS MANUFACTURING COMPANY

SENECA FALLS, N. Y.

GOULDS

Kilby Frog & Switch Co.

Birmingham, Ala.

Manufacturers of

**Railroad Crossings,
Frogs and Switches**

**Manganese Track Work
a Specialty**

**Balkwill Cast Manganese
Articulated Crossings**

Graham Flange Frogs

(The Savers of Maintenance)

How many of your water columns are knocked down every year?

What does the repairs and maintenance—not the result of ordinary use—cost you?

Avoid this annoyance, trouble and expense by using a

POAGE Style "H" WATER COLUMN with FENNER DROP SPOUT

The three foot lateral range in the Fenner spout and the steel riser in the Poage Style H save the water column from being knocked down by the shifting of the tender.
The tender has to leave the track to knock this column down.
The flexible spout makes it unnecessary to spot the tender accurately. You save time by quick adjustment.
The five foot up and down range enables the water column to fill a tender of any height.

How lateral movement of spout prevents column being knocked down

The open telescopic joint does not waste a drop of water. It banishes the usual winter time troubles. Ice does not collect upon it.

The valve permits the maximum amount of water to flow in the shortest time. There is a minimum or frictional resistance. It shuts the water off quick without water hammer.

Try the Poage Style H column. You will find that it has remarkable operating advantages.

Manufactured Exclusively By

The American Valve & Meter Co.
Cincinnati, Ohio

ECONOMY

American Lime-Soda Water Softeners treat feed water to prevent scale in locomotives. This means:—

1. Saving in fuel.
2. Saving of cost of labor for cleaning and repairing locomotives.
3. Saving in loss in mileage due to shopping locomotives for cleaning and repairing.

Investments in AMERICAN WATER SOFTENER COMPANY LIME-SODA WATER SOFTENERS pay dividends of from 50% to 100%.

Write for Our Literature

AMERICAN WATER SOFTENER CO.
Fairhill P. O. PHILADELPHIA, PENNA.

Specialists for twenty-two years in
Railroad Water Purification

A through freight pounds by

WATCH a big Mogul with a string of heavily loaded freight cars—thundering down the track. Figure the impact on rail-ends as this great weight crashes along.

Diamond Fibre Railway Insulation was produced to meet the need for a track insulation of great strength and durability. It stands up under excessive strain. It does not crystallize under vibration.

Diamond Fibre Railway Insulation is high in dielectric strength. It resists absorption. The material is dense, tough, homogeneous.

We also manufacture Celoron, for insulating use where exceptional mechanical strength is necessary.

Many large railway systems have cut down maintenance costs with Diamond Fibre and Celoron. We furnish these materials in finished parts for railway use, and in sheets, rods and tubes.

It will pay you to write for samples and quotations.

Diamond State Fibre Company
Bridgeport, Pa., and Chicago, Ill.
Branches in Principal Cities Toronto, Can.—London, Eng.

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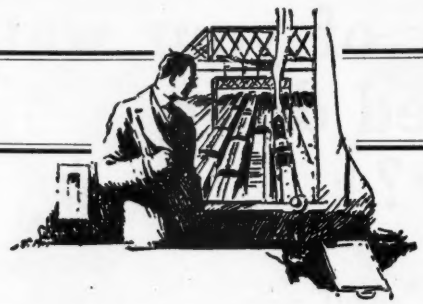

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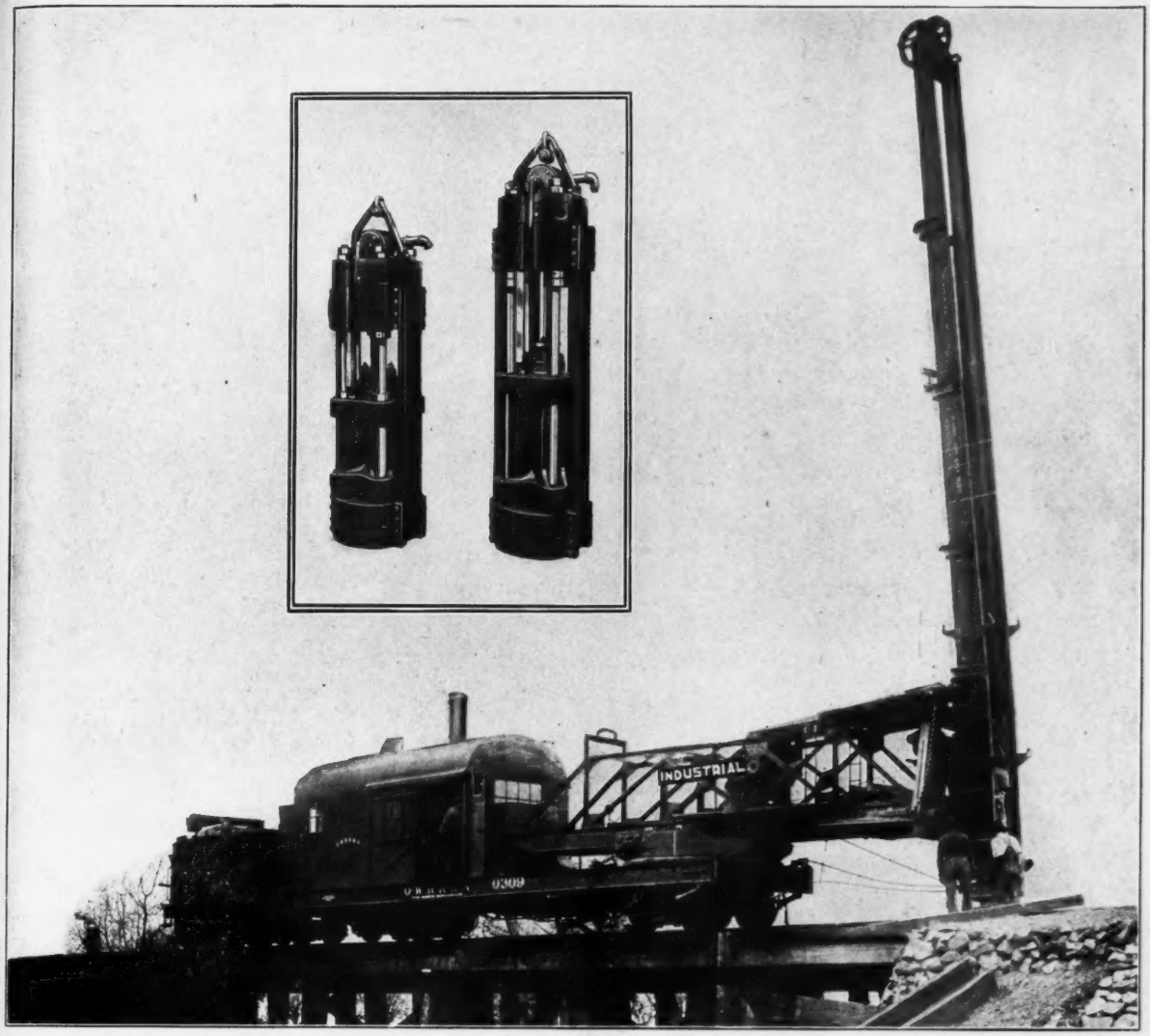

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